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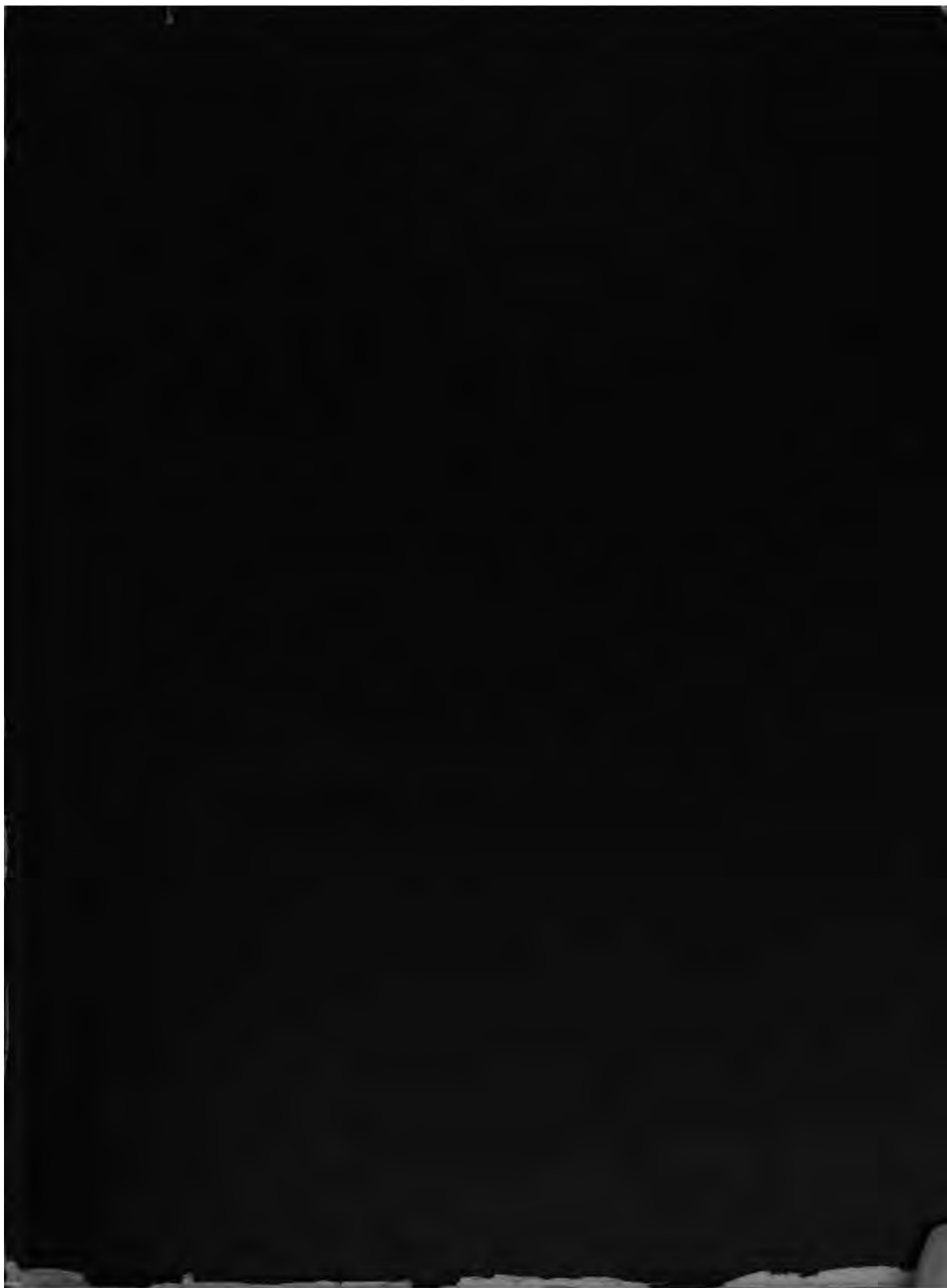
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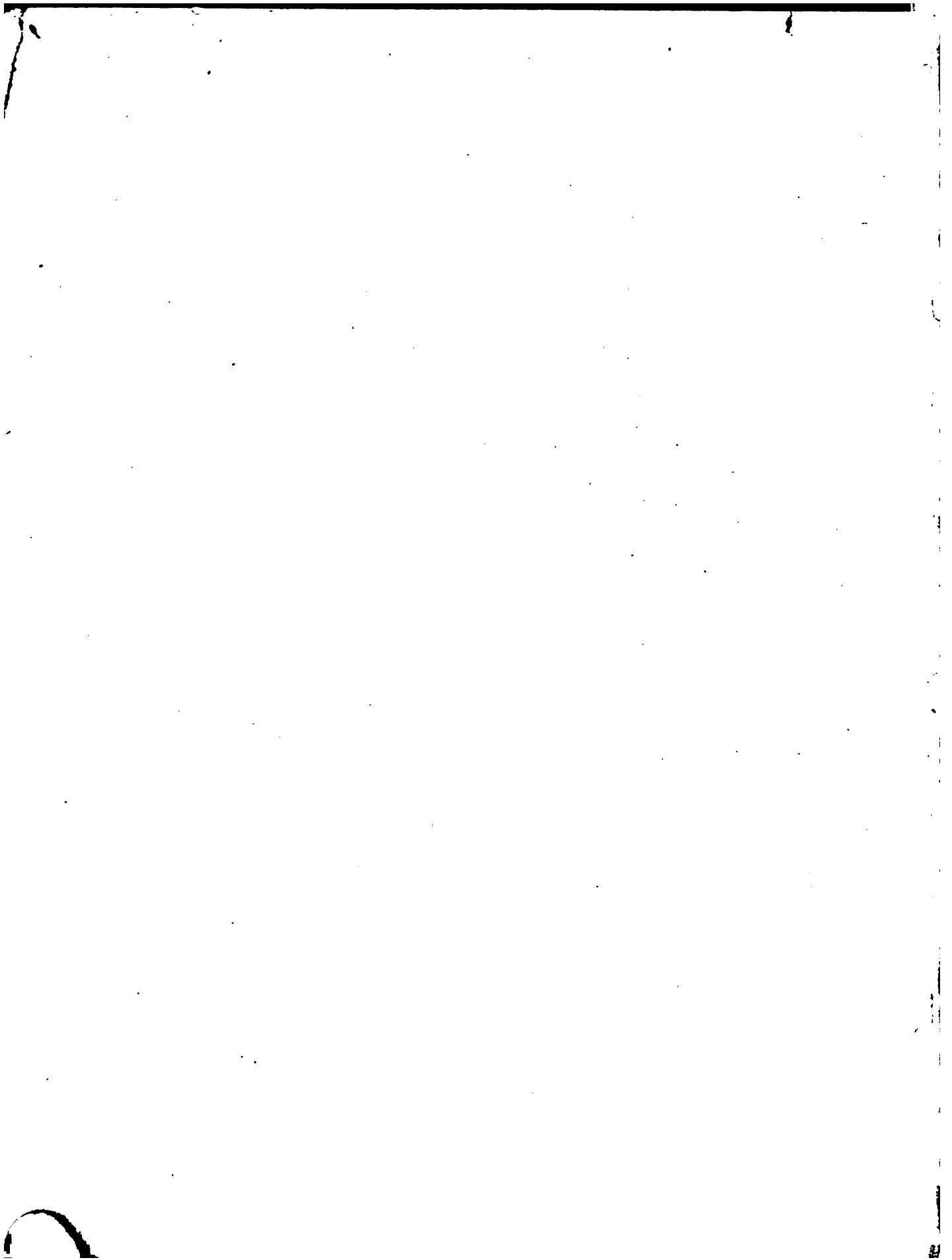
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ON
CENTENARIANS;
AND THE DURATION OF THE HUMAN RACE;

A Fresh and Authentic Enquiry;
WITH
HISTORICAL NOTES, CRITICISMS, AND
SPECULATIONS.

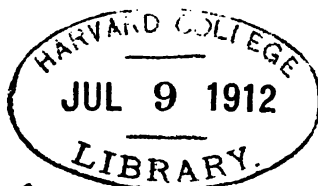
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A PRELIMINARY NOTE UPON THE TERM "CENTENARIAN."

i. In the "New English Dictionary on Historical Principles," edited by Dr. J. A. H. Murray, it is noted that the word is constructed on the basis of the Latin "*centenari-us*" (a form of *centens*, which is itself a form of *centum*); and its earliest employment as an adjective is traced to the year 1849; while its first use as a substantive appears to date from 1846.

ii. It is further observed that the term "Centenary" is very rarely substituted as an equivalent to Centenarian. For example, in "The Doctor," by Robert Southey, the poet, Chapter cxxxii., he adopts the word in the plural, "Centenaries," as expressing the fact of surviving 100 years, or a Centenarian.

iii. In the very interesting but erratic volume, published in 1873, by Mr. FitzEdward Hall, and entitled "Modern English," the term "Centenary" is traced, though not as an equivalent to the word "Centenarian," but as a synonym for "Century," to 1607, 1630, and 1636. The word "Centenarian" was unknown to Johnson.

iv. Entertaining some uncertainty upon the subject of the composition of the word,—especially observing that Haller, in his "Elementa Physiologiae," had never employed it, although he furnished several citations from the Latin Authors and particularly from Pliny's "Historia Naturalis,"—I consulted one of our leading Classical scholars, who informed me that the proper Latin word to express "a man 100 years old" would be *Centenarius*. The term, he adds, though not uncommon in Latin, happens not to be quoted in this particular sense; but that this is no more than an accident is proved by the occurrence (*inter alia*) of *quadragenarius*, *quinquagenarius*, *octogenarius* in the sense of "a man 40, 50, 80 years old." All these possess valid Classical authority, and are precisely analogous in formation with *Centenarius*; while *Centenarian* is framed from the Latin *Centenarius* on sound analogy: similar to words like *disciplinarian* and many others,—so also *Episcopalian* and *Mammalian*, constructed from Latin adjectives in *-alis*. The formation of Centenarian is thus abundantly justified.

The term "Centenarianism" is not yet naturalised.

ON
CENTENARIANS;
AND THE DURATION OF THE HUMAN RACE:

A Fresh and Authentic Enquiry;

WITH

HISTORICAL NOTES, CRITICISMS, AND
SPECULATIONS.

CHAPTER I.

THE OCCASION OF THE PRESENT ENQUIRY, AND ITS RESULT.

THE question of the duration of the human race, and particularly the potential and actual longevity of individual man, has always possessed an attraction for the speculator and statistician. The antiquity of the Earth; the physical origin of the Universe; the stage of evolution at which the Solar System and its several spheres have at present attained;* have more especially and prominently engaged the attention of Geologists and Physicists; and although, in consequence of the impressive deductions of Scientists, the modern results of mathematical and scientific investigation into these problems of engrossing interest, are gradually revolutionising the entire compass of our current modes of conception

* This interesting enquiry has not yet received the scientific attention it deserves. The transcendental philosopher, Kant,—assuming that a certain average duration appertained to each planet of our System,—a definite æonian life,—propounded the question,—not as to the precise age of our Earth, but—of the specific Era in its developmental evolution at which it had now arrived.

in every region of thought, it is the question of racial and personal extent of existence which has more peculiarly impressed itself upon the popular imagination.

I purpose to submit hereafter a few reflections upon the necessary connexion and mutual dependence between the age-history of the Universe, the race, and the individual, but my preliminary chapters are concerned with the teachings of statistics and the application of historical methods.

Previous investigations into human longevity have necessarily been limited, almost exclusively, to the records of the general population, with the exception of some scanty references to the experience of Life Assurance Companies.* The authoritative statistics of these Institutions have recently become available, and, considering the adequate tests which are employed by these Bodies in the determination of age and identity, and their competent analysis of results, we now possess, for the first time, a genuine and discriminated mass of evidence, credible, as far as human and interested foresight and sagacity can command, beyond suspicion or dispute, which impresses the enquiry upon which I have entered with the seal of finality. In previous researches, restricted, from the necessity of the case, to the population at large (if we except special individual instances where adequate proof was procurable), the difficulties attending the settlement of age and identity were practically insuperable, or only obtainable after very imperfect and precarious examination; but, in the records of Assurance Offices, where these elements form a definitely constitutive part of the necessary procedure, the results are based upon authentic and virtually indisputable grounds. For, in Life Assurance and Annuity transactions, the precise establishment of the age and identity of the Assured and Annuitant is an essential factor of the solvency of those Institutions, and hence is scrupulously and minutely regarded.

* For example, the instances cited by Dr. Webster, in the "Athenaeum" for January the 31st, 1857, obtained from the Registers of Assurance Offices, where the extreme age at death had been 97 in the "Amicable" and the "Pelican."

The illustrious Astronomer and Physicist, Dr. Edmund Halley* had the merit of first drawing attention to the important element of age in Mortality statistics as applied to Assurance calculations, and the distinguished Grand Pensionary of Holland, Johan de Witt,† is also justly honoured as a coequal precursor in the same direction.

Omitting the factor of the rate of interest as irrelevant to the object in view, the essential consideration in Life Assurance and Annuity obligations consists of the rate of mortality to be employed, both in assessing the scale of premiums to be charged, and also in periodically estimating the Reserve Fund which a company should possess for the purpose of redeeming its contracts as they successively mature.

In a future chapter, I purpose describing briefly a few of the Mortality Investigations which have been completed in Great Britain, in relation to the number of supposed Centenarians they have apparently disclosed ; but, at present, I confine my observations to the two sources from which my examples of excessive lifetime have been derived.

The Institute of Actuaries and the Faculty of Actuaries (respectively founded in 1848 and 1856, and incorporated by Royal Charter in 1884 and 1868) are now engaged in collecting and tabulating the statistics of Mortality experience of Life Assurance and Annuity Societies established in this country, terminating with the year 1893 ; and in calculating, on the basis of these data, Tables of the Rates of Mortality and of the mathematical functions to be employed in Actuarial computations. This immense mass of details comprises observations, in round numbers, upon upwards of 800,000 lives (accepted at the ordinary rate of premium) in respect of Life Assurance (contributed by 62 offices), and about 6,700 males with about 18,900 females (collected from 46 companies), upon whose lives Annuities had been granted. The total years of existence, embraced

* Philosophical Transactions of the Royal Society : reprinted in the *Journal of the Institute of Actuaries*, Vol. xviii.

† *Journal of the Institute of Actuaries*, Vol. ii. and Vol. iii.

within the period of survey (from 1863 to 1893) in connexion with Annuities alone, exceeded 227,000 years. This admirable enterprise, it is confidently and justly conceived, will possess an importance and significance,—as exemplifying the value of life prevailing under modern sanitary and medical conditions,—ranging far beyond the particular professional and business requirements to which it will be primarily devoted.

The Actuary of the National Debt Office, Mr. A. J. Finlaison, C.B., presented, on the 10th of February 1883, to the National Debt Commissioners and the Lords of the Treasury, a Memorandum* expressive of the rate of mortality which had been experienced up to 1875 among the Nominees on whose lives Annuities had been purchased from the Government. The collection of facts embodied observations, extending over a period of 67 years from 1808, upon 10,929 males and 19,859 females, with the aggregate of 430,595 years of life.

It is from these authentic data,—the current investigation of the Institute of Actuaries and the Faculty of Actuaries, and the completed experience of Government Annuitants,—that my examples of Centenarians are derived ; and, as I have mentioned, we thus, for the first time, possess an authoritative record of prolonged duration of life where the tests of age and identity have been rigorously and consistently applied and fulfilled.

It has proved a constant result of observation that the rate of mortality among female lives was inferior to that of males ; during the child-bearing period, it is true that women exhibit a higher mortality than that prevailing among a corresponding body of men of similar ages ; but the superior longevity of females, after the term of child-bearing has elapsed, becomes so distinct and pronounced that its excess over that of males is sufficient to compensate the deficiency of vitality during the prior period, and thus to confer on female life, throughout its *entire* duration, an enhanced probability of prolonged

* Report on the Mortality of Government Life Annuitants.

lifetime over that appertaining to males. Hence, my results are distributed into (a) Assured Lives: Males; (β) Assured Lives: Females; (γ) Annuity Nominees: Males; (δ) Annuity Nominees: Females. In accordance with the desire of several Companies, whose courteous aid to me in this enquiry I gratefully express,—and I gladly include, in this tribute of sincere acknowledgment, the Chief Officials of the National Debt Office,—I furnish only the initials of the names of the persons whose record is presented.

Initials of Name.	Date of Birth ["Bp." signifies that only the date of Baptism was proved.]	Date of Death.	AGE AT DEATH.			AGE IF LIVING ON THE 31ST OF JULY 1898.			Social Status.	Single (S); Married (M); or Widow or Widower (W).
			Years.	Months.	Days.	Years.	Months.	Days.		
(a) ASSURED LIVES: MALES.										
J. W. L.	May, 1767	23rd June 1870	103	1	8	—	—	—	Superior	?
E. H. A.	1769	31st Oct. 1870	101	4	—	—	—	—	Superior	?
M. M.	24th Oct. 1784	28th July 1885	100	9	4	—	—	—	Superior	W
W. H.	21st Aug. 1794	10th Sept. 1894	100	—	20	—	—	—	Moderate	?
(β) ASSURED LIVES: FEMALES.										
None.										
(γ) ANNUITY NOMINEES: MALES.										
W. L.	10th May 1774 [Bp.]	12th Feb. 1877	102	9	2	—	—	—	Superior	?
D. R.	28th Feb. 1755 [Bp.]	2nd March 1857	102	—	2	—	—	—	?	?
D. F.	12th Aug. 1772	5th Nov. 1872	100	2	24	—	—	—	Moderate	M

Initials of Name.	Date of Birth ["Bp." signifies that only the date of Baptism was proved.]	Date of Death.	AGE AT DEATH.			AGE IF LIVING ON THE 31ST OF JULY 1898.			Social Status.	Single (S); Married (M); or Widow or Widower (W).
			Years.	Months.	Days.	Years.	Months.	Days.		
(8) ANNUITY NOMINEES: FEMALES.										
M. A. W. G.	21st June 1791 [Bp.]	21st Feb. 1897	105	8	—	—	—	—	?	W
C. H.	17th April 1783 [Bp.]	2nd Feb. 1888	104	9	16	—	—	—	?	S
S. P.	11th Dec. 1772 [Bp.]	9th Oct. 1896	103	9	28	—	—	—	?	M
F. M. de L.	27th Aug. 1788	3rd Dec. 1891	103	3	7	—	—	—	?	M
C. M. T.	6th Jan. 1794	16th March 1896	102	2	10	—	—	—	Moderate	S
A. M.	8th Nov. 1780	16th Dec. 1882	102	1	8	—	—	—	Moderate	S
A. F.	4th March 1792	25th March 1894	102	—	21	—	—	—	?	S
D. Y.	27th Sept. 1796	—	—	—	—	101	10	4	?	S
H. K.	17th May 1788	11th Feb. 1890	101	8	25	—	—	—	?	S
E. S.	26th May 1785 [Bp.]	12th July 1886	101	1	16	—	—	—	?	S
J. S.	20th June 1766 [Bp.]	24th July 1867	101	1	4	—	—	—	?	S
M. A.	1st March 1762	2nd March 1863	101	—	1	—	—	—	?	S
R. N.	21st Sept. 1788 [Bp.]	27th April 1889	100	7	6	—	—	—	?	S
H. W.	1787	9th Jan. 1888	100	6	9	—	—	—	Moderate	S
M. J.	2nd Oct. 1779	12th Nov. 1879	100	1	10	—	—	—	Superior	S

I am permitted to mention that "M.M." is the well-known philanthropist, Sir Moses Montefiore.

I have noted the cases where the primary evidence of age consisted of the Baptismal Certificate, and hence it is evident that, in the majority of those instances, the longevity was superior to that which I have expressed.

Two persons in the preceding Table had purchased Annuities both from an Assurance Company and the National Debt Office; while one had bought Annuities from two Life Offices. One of these duplicates has, of course, been excluded, so that each entry represents a different individual.

There are thus 22 indisputable examples of Centenarians, with ages ranging to upwards of 105. It is noteworthy that no Assured female had reached 100; of the total number, 18 represent Annuity purchases, of whom 15 are females. The average age at entry of the Government Annuitants was upwards of 76 years in the case of males (but the numbers are scanty), and nearly $63\frac{1}{2}$ years in respect of females. Mr. Finlaison states, in his Report, that 65 per-cent of the entire number of Annuitants upon the Registers entered between the ages of 50 and 70, while 82 per-cent of the Contracts were upon lives who purchased at ages exceeding 50. The proportion of Annuitants entering at ages under 40 was only about 5 per-cent of the aggregate number.

The predominant vitality of female lives is impressively exhibited by the fact that the average age of the 15 female Annuitants was upwards of 102 years and 1 month.

It would almost appear that, in the constitution of the female sex, an intenser inherent power of survivance exists; or, possibly, this enhanced vitality may be due,—and certainly this feature forms an important partial factor,—to the circumstance that Annuitants are self-selected lives; that is to say, only those persons, on the *whole*, purchase Annuities who,—from family history, ancestral longevity, and dependence upon their own natural vigour,—anticipate, with reasonable confidence, an exceptional duration of life. I am

inclined to believe that the application of the antiseptic principles of Surgery in the innocuous removal of internal tumours, peculiar and frequent to females, has also definitely contributed to the prolongation of their lifetime on the whole. The experience of one of our largest Metropolitan Hospitals shows that, prior to 1878, the death-rate from the operation of Ovariectomy varied from 65 to 87 per-cent, while it has now been reduced, in consequence of the introduction of these improved methods, within a range of 7 to 10 per-cent; and I am informed that this result may be regarded as typical of Hospital statistics generally upon this subject.

Moreover, in Annuity experience, the preponderant purchase of Annuities upon the lives of female nominees after the age of 50, when the danger from child-bearing has ceased, attests that, practically, specially select lives are alone involved. It will, further, be noticed that the grants of Annuities are virtually confined to females whose native constitutional vitality and self-selection are reinforced by the absence of child-bearing hazards, which, according to the researches of Dr. Matthews Duncan,* prove fatal approximately in 1 out of every 120 parturitions in London. It will here be remembered that 12 out of the 15 females in the Table were single.

I may add, in passing, that, seeing that Annuities are chiefly purchased on the lives of females, the record of longevity exhibited in the preceding Table emphasises the teaching of general experience that the practice of Annuity business,—now largely increasing in consequence, mainly, of the continuous decline in the market rate of interest upon sound investments,—is in no degree likely to contribute a profit to the Companies which favour this description of transaction. This contention is enforced, also, by the fact that, in Life Assurance, an improvement in the general rate of mortality is favourable to the Companies and partially counteracts the adverse influence of the reduced return from interest obtainable upon their Funds, while, in Annuity business, *both* these elements combine in joint action against the prosperity of the offices.

* Fecundity, Fertility, Sterility, and allied Topics: Part vii., chap. i.

It is of interest, as a fact in Assurance history, to mention that, presuming that the general tenacity of life displayed by females, when their entire lifetime is considered, might be regarded as a vital attribute of sex at every stage, one Assurance Company at least formerly granted Life Policies to females at lower rates of premium than those required from males; but since Assurances on women only occur, as a rule, during the child-bearing period, the grave error of this unsagacious inference was speedily made manifest in excessive claims by death, which compelled a reconsideration of the practice, and the subsequent admission to Assurance of females on the same terms as those exacted from males. And for a considerable period, an important section of Assurance Companies,—basing their conclusion upon a careful analysis of the experienced duration of life among women,* which showed that, out of two bodies of males and females, 10,000 in number, the deaths in one year, between the ages of 20 and 44, were about 85 in respect of males, and 111 in the case of females,—adhere to an extra charge of 5s. per-cent per annum to the age of 50, for the purpose of compensating the additional risk consequent on child-bearing.

I may append to my Table the following four instances, where death occurred at an age exceeding 99.

Initials of Name.	AGE AT DEATH.			Description.
	Years.	Months.	Days.	
J. O.	99	11	23	Male Assured.
J. P.	99	11	7	Female Annuitant.
G. S.	99	9	10	Male Assured.
S. W.	99	7	30	Male Annuitant.

Although my enquiry is restricted to instances of Centenarians exhibited in the experience of Assurance Companies and the National Debt Office, I admit two examples, external to these records, where the evidence is complete.

* *Journal of the Institute of Actuaries*, Vol. xix.

Mr. Charles D. Higham,* the Actuary, has furnished the particulars of a well-known family, remarkable for its general longevity, where one daughter attained the age of 102'1.

Mrs. Margaret Anne Neve, a native of Guernsey, was born on the 18th of May 1792, and reached the age of 106 in May last, in comparatively vigorous mental and bodily activity. She presented all the characteristics which Dr. Humphry has delineated as typical of those destined to prolonged life ; and, at the age of 91, travelled over the Continent for the purpose of reviving her former cherished remembrances of famous places.

With a view to rendering the Book more interesting and complete, I have added chapters containing some tentative speculations upon the possibility of the approximate determination of the causation of extreme longevity ; describing the enquiries and views of previous investigators, with a record of their established and dubious results ; dealing with the question of the extent of credibility to be attached to the excessive ages ascribed to National representative Characters and heroes, in the primitive traditions especially of the Hebrew Race ; and I have further ventured to submit a few suggestions and considerations based upon statistical and physiological doctrines and phenomena, with the relevant and impressive results of Bacteriological research.

* *Journal of the Institute of Actuaries* ; Vol. xxx.

CHAPTER II.

THE DIFFICULTIES ATTENDING THESE INVESTIGATIONS.

IN the examination of alleged instances of Centenarians among the general population, the difficulties of determining the age and identity are always pronounced, and frequently insuperable. And, undoubtedly, Mr. Thoms is entitled to the unstinted praise of subsequent investigators for the scrupulous care, minute research, unwearied vigilance, and, (in the original sense of the word), "painful" labour, which he displayed in his valuable and detailed enquiry which I shall describe more particularly in Chapter III.

- i. The Certificate of Birth or Baptism is often difficult to procure, especially in the records of the poorer classes, whence formerly these pretended examples of longevity have usually been derived.

When the Papal Authority in England was openly contemned,* and Henry the 8th declared the Supreme Head of the Church, Thomas Cromwell was created Vicar-General, and entrusted, in October 1535, with a Commission for the Visitation of Religious Establishments. This Visitation formed the occasion of new Protestant Regulations for the Kingdom generally, and, among them, was included an Injunction, framed in September 1538, by Cromwell, whose 12th Article provided that every Parson, Vicar, or Curate, should keep a faithful account of the Weddings, Christenings, and Funerals in his Parish. (Until the dissolution of the Monasteries, no Parish Registers existed in England). Cromwell's Visitation forms accordingly the origin of our general Registration of Deaths,

* E. J. Farren : *An Historical Essay on the Rise and Early Progress of the Doctrine of Life Contingencies in England.*

The English Cyclopædia : s.v. Registration of Births, Deaths, and Marriages.

for, although Dr. Short (in 1740-1750) collected Registers of Christenings and Burials of 160 country Parishes, he discovered no example of any Register prior to 1535-1538.

In the first year of Edward the 6th (1547), a fresh Visitation and Inquisition was ordered, for enforcement, throughout the Kingdom, of Cromwell's rules relating to Parish Registers; and an attempt was made, though finally abandoned, to establish a Treasure House in every County where the Records might be preserved.

During the reign of Mary, and the re-assertion of the Papal supremacy, the system of registration, by reason of its execution depending upon beneficed clergymen, probably fell into disuse.

In Elizabeth's time (1558), the Injunction to Parsons, Vicars, and Curates was re-issued; and all former Registers were required to be copied into parchment volumes.

The Registration of deaths appears to have been the more completely practised in the country generally; but the Metropolis seems to have totally evaded the ordinances, for it was not until the occurrence of the Plague in 1562, that we find any record of London Burials instituted; and, when the Plague subsided, the Metropolitan registration of Burials was concurrently discontinued. In 1603, on the re-appearance of the Plague, Bills of Mortality were resumed in London, and thenceforth continued to be issued irrespective of the visitation of that scourge. The Fraternity of St. Nicholas, who had hitherto undertaken the supervision of the registration, was incorporated, in the reign of James the 1st, as the Company of Parish Clerks, and was formally entrusted with the publication of the London Bills of deaths. To complete this historical portion of the subject, I might add that these arrangements were re-constructed in 1836 (6th and 7th Wm. 4, cap. 85), when the present General Register Office was established.

To revert for a moment to an earlier stage, an Act (6th and 7th Wm. 3, cap. 6) was passed in 1695 for the general registration of Births, Marriages, and Deaths, but its essential object was the raising of Revenue. The duties levied varied with the degree of

social rank: the tax on each burial amounted to 4s., with an additional rate (ascending according to social position), of which the highest stage was £50 in respect of the death of a Duke or Duchess; the duty on each birth was 2s., with an increasing scale terminating at £30; while each marriage contributed a tax of 2s. 6d., with an augmenting rate which reached its maximum at £50.

The Acts of Parliament which comprise the essential features in the history of Civil Registration are the 6th and 7th Wm. 4, cap. 85, the 6th and 7th Wm. 4, cap. 86, the 7th Wm. 4, the 1st Vict., cap. 22, and the 37th and 38th Vict., cap. 88.

- ii. Where no Certificate can be adduced, documentary evidence of some adequate kind is essential, and is frequently impossible to procure. Family Bibles or Family Registers,—in which, according to ancient fashion, the births of children were recorded by the parents as each was born,—are not commonly possessed; and the difficulty, where they are producible, is increased by the fact that, in many instances, the birth was not entered at the time of its occurrence, but at a subsequent date on the evidence, possibly, of a fallacious memory, while the enquiry is embarrassed in the latter case by the practical impossibility of deciding whether the entry is authentic, *i.e.*, made by those who are personally acquainted with the date.
- iii. Authoritative evidence furnished by other Centenarians who possess a *personal* knowledge of the date of birth of the assumed Centenarian, and can presumably testify to the fact, —(and no other witnesses, in the absence of documentary proof, can be accepted but those who are practically Centenarians themselves),—is, from the nature of the case, usually inadmissible, for this mode of evidence implies in the declarant a longevity coeval with the alleged age of the subject, which suggests the antecedent enquiry,—“*Quis custodiet custodes ipsos?*”
- iv. The age recorded in the Certificate of Death is not conclusive. The Registrars are not authorised to demand

proof of the statement before issuing a certificate, and depend exclusively upon the simple and unsupported testimony of the statutory informant who reports the death. Mr. Thoms* cites an example, which he personally investigated. In the Obituary of "The Times" for the 20th of September 1873, a death was recorded at the age of 107. On enquiry, Mr. Thoms ascertained that the daughter of the deceased, acting on information supplied by her brother-in-law, furnished that age to the Registrar; but closer investigation proved that the age could not have exceeded 98 to 101; and, even for that, the evidence was defective.

- v. Tombstones are sometimes appealed to as forms of evidence. Their laudatory inscriptions are proverbially untrustworthy certificates of character, and the same comment applies to the records of the date of birth, or of the age, which they display. "In lapidary inscriptions," said Dr. Samuel Johnson,† "a man is not upon oath." These records are sometimes falsified unintentionally through the ignorance, or defective skill, or imperfect workmanship of the carver; for example, at Chave Priory, Worcestershire, the age of a "rude forefather" is inscribed as 309, due to the hazy notions of numeration of the village workman who, desiring to chisel the number 39, placed the 30 first and the 9 afterwards.‡ In a churchyard at Bickenhill, in Warwickshire, the age of a maiden lady, who died in 1701, is engraven as 708, which probably in a similar manner is intended for $78 = 70 + 8$. The "weathering" effects of the atmosphere again destroy or abrade the chiselling of the figures, and render decipherment precarious; obliterating the record altogether, or cancelling and obscuring the difference between numbers of a somewhat similar form; and various attempts are sometimes perpetrated, by a subsequent and deliberate

* Human Longevity; its Facts and its Fictions: chap. iv.

† Boswell's Life of Johnson: year 1775.

‡ W. J. Thoms: Op. cit.: chap. iv.

alteration of a numeral, for the purpose of amusement, or even of fraud in connexion with pedigrees and the disputed titles to estates.

- vi. But even where the proof of age is placed beyond suspicion, the difficult question arises of the supreme necessity of *identifying* the supposed Centenarian with the child recorded in the Certificate, or other approved document. And, especially, is this trouble enhanced in cases where the name is a common one, increasing in proportion with the frequency of occurrence of *both* Christian and Surname; and, particularly again, when the name has been changed by marriage or deed. It is then imperative to adopt the two-fold process of adequately identifying the new surname with the name previously borne, and the name so verified with the name of the child contained in the Registry. In the recent experience collected from the statistics of Life Assurance Offices, the name of "Smith" occurred upwards of 11,000 times in the "whole-life" Assurance records of males alone, and the simple name of "John Smith" was found in over 1,000 instances. This difficulty is immeasurably augmented by the established custom in families of perpetuating a prominent, distinctive, or honoured family name, as a Christian name: a child bearing it dies; another child is born, and receives the favoured name; and this may occur two or three times in succession. It may then happen,—and this has proved a frequent example,—that the person, who is supposed to have attained to the age of 100, is assumed, from the particularity of the name, to be identical with the first child born who received that name, while, in reality, he is the third born who may never have reached 100.* This perpetuation of favourite family-names is very prevalent; and special illustrations which occur, for example, in the history of the ancient

* W. J. Thoms: Letters to *The Times* in 1872 upon "Centenarians, and Baptismal Certificates: Longevity as viewed by Medical Men." And "Human Longevity," chap. iii.

Hebrew race,—where the name of Mary or Miriam is bestowed in commemoration of a famous Miriam of primitive story,—constantly puzzle interpreters in disentangling genealogical records.

- vii. And, finally, there exists the well-known tendency of very aged people to exaggerate, without wilful intention to deceive, the age to which they have attained: the pride of mere prolonged existence,—(difficult though it is to understand and appreciate); the sympathy and admiration of friends; the interest and wonder displayed by strangers; the special aid and solicitude exhibited in the poorer classes towards advanced age*,—all these sentiments tend to render the remembered and unattested ages of old people peculiarly deceptive.

In the instances I have mentioned in pages 9 and 10, these embarrassments,—which adhere ineradicably to enquiries into the *general* population,—it may be reasonably stated, have been scrupulously and successfully surmounted.

In the grant of Annuities, it is the invariable practice to require sufficient proof of age and identity, on adequate documentary evidence, *before* the Contract is completed; each payment of the annuity demands an authentic declaration from some approved person, and after personal observation, of the existence and identity of the annuitant claiming. Mr. A. J. Finlaison, C.B., the Actuary of the National Debt Office, observes, on these points,† that formal proof of the ages of the Annuitants, and of their existence from time to time, is exacted; that, in the great majority of instances, the evidence of age consisted of a copy of the Register of Births and Baptisms, authenticated by a Parish Minister, while two witnesses must attest his signature, from one of whom is also obtained a Statutory

* Sir Geo. C. Lewis: in an Article on "Centenarians" in *Notes and Queries*: 3rd Series: Vol. i.: the 12th of April 1862.

The Honourable L. A. Tollemache: "Safe Studies."

† Report on the Mortality of Government Life Annuitants (February 1883).

Declaration that he had examined and compared the copy with the original record. And, prior to the issue of an annuity, a Statutory Declaration from a competent person is also necessary, identifying the nominee with the child whose name is entered in the Certificate. Where exceptional evidence of age has alone been feasible, the most vigilant scrutiny is exercised to ascertain its authentic character. From time to time again during the currency of the annuity, the existence of the nominee is closely watched, and the payment of each instalment is dependent either upon the personal appearance of the applicant at the National Debt Office, or upon documentary proof that the annuitant had been seen alive by an authorised person at the date when the amount became due.

A similarly strict requirement is also exacted by Companies which issue Annuities.

If, in Life Assurance, the age has not already been rigorously established at the date of the Proposal, adequate proof both of age and identity must be produced to the Office prior to the payment of the Claim at death. And, in the cases I have cited of the identity of names occurring in the current investigation of the Institute of Actuaries and the Faculty of Actuaries, the most minute care has been exercised, based upon specific enquiry of the Companies and suggested by the additional facts recorded on the schedules appertaining to each life, for the purpose of accurately discriminating between the several persons possessing a similar name.

It is obvious that, at the outset, the ages of Annuitants are more likely to be exaggerated than those of the applicants for Assurance, since a higher age, in the former case, involves a larger amount of annuity, while, in the latter, it entails a heavier premium. This fact demands, and receives, a stricter scrutiny by Companies before an annuity is granted. And, moreover, it may be safely left to Assurance Institutions and Annuity Societies to adopt the most rigid safeguards, as the rates of annuity and premium, and the Valuation Reserves, depend upon the ages, and the solvency of these Associations rests (*inter alia*) upon the precise accuracy with which this element is determined.

An interesting fact in the general subject may here be finally noted. It is often urged, in proof of extreme age, that old people cut a third set of teeth. Professor Owen* explains this error by stating that, in advanced age, the gums tend to recede, and, consequently, the stumps of teeth, previously hidden, are thus exposed to view, and give rise to the supposition that a third set is being formed.

* An Article "On Longevity," in *Fraser's Magazine* for February 1872.

CHAPTER III.

A RECORD OF SOME PREVIOUS INVESTIGATIONS, AND THEIR RESULTS.

- i. IN 1873 appeared an important work by Mr. W. J. Thoms,* Deputy-Librarian to the House of Lords.

All students of the subject must entertain a feeling of deep respect for the careful and exhaustive researches of Mr. Thoms. An inquiry into the records of Centenarians such as that which I have instituted is a comparatively simple and unpretending task, limited, as it is, to a definite and selected range of cases; but an investigation into the miscellaneous, intricate, and confused materials exhibited by the *general* population, which Mr. Thoms so successfully attempted, demands a scale of patient analysis, of scrupulous and minute discrimination, and of incredible labour in the disentanglement of conflicting evidence, which few men are competent to achieve.

I omit the valuable and sagacious remarks of Mr. Thoms upon the difficulties and canons of proof, which his experience prompted and confirmed, as I have incorporated them in various parts of this Book; and I proceed to present his method of examination and the results he obtained.

The three typical instances of abnormal longevity, which are constantly cited, are those of Henry Jenkins, Thomas Parr, and the Countess of Desmond; and with these the author has conclusively and finally dealt by establishing beyond doubt their mythical character.

Henry Jenkins is stated to have been born in 1501, and buried on the 9th of December 1670. The earliest account of him which

* *Human Longevity : its Facts and its Fictions.*

we possess is that of Miss Ann Savile, which is accepted, on reasonable grounds, as having been composed in the year 1662 or 1663; and upon her statement is mainly based every shred of authority which attaches to Jenkins's age. Miss Savile,—whose statement is contained in the Philosophical Transactions of the Royal Society, Vol. xix, No. 221 for 1696,—records that, when she first took up her residence in Bolton, in Yorkshire, she was informed that a man lived in the parish who had attained the age of about 150. For several years she attached no credence to the rumour; but, on a certain day, Jenkins entered her sister's kitchen to beg, and she then exhorted him, on the ground that he must shortly render an account of his statements to God, to speak the truth about his age. She reports that, after pausing for a time, to collect the scattered fragments of his memory, he solemnly affirmed that, to the best of his remembrance, he must be about 162 or 163. Upon this absolutely unsupported assertion of the man himself, has been erected the fabric of his egregious term of life. Miss Savile adds that Jenkins could neither read nor write. The Register of Burials for Bolton-on-Swale has been examined, and, beyond the record of his name and the addition that he was "a very aged and poore man," no further evidence can be discovered; the Register does not even contain his reputed age. Canon Rainie, in response to Mr. Thoms's enquiry, informed him that this entry was the sole notice of Jenkins which the Parish Register disclosed. Mr. Thoms accordingly found no difficulty in demonstrating that the entire testimony consisted merely of the vagrant's own unconfirmed assertion, and must therefore be absolutely discarded. Henry Jenkins vanishes, therefore, without difficulty or hesitation, into the limbo, not simply of unproved, but of definitely disproved pretensions. The case merely furnishes an example of the frequently unintentional exaggeration of age in which, as a rule, old persons, and especially the ignorant, are apt to indulge. This instance of alleged longevity, I may add, as appears from Haller's "*Elementa Physiologiæ*,"* was presented in the pages of the *London Magazine* for 1753.

Thomas Parr appears undoubtedly to have been an extremely aged man, of probably 100 years of age, and possibly one or two

* Vol. 8: The section entitled "*Longævorum Enumeratio*."

years more ; especially as the autopsy by the distinguished Physician, William Harvey (the discoverer of the circulation of the blood), confirmed the *general* statement of his advanced age. He is supposed to have been born at Winnington, in the Parish of Alderbury, in 1483, while his death is recorded on the 14th of November 1635. If these dates could be attested, his age at death would be 152 years 9 months and a few days. His reputation for extreme age depends exclusively upon his own assertion, and upon the lucubrations of John Taylor,* who published a metrical (and doggerel) history of Parr in 1635, though, unhappily, Taylor furnishes no facts or figures of any description, proved or capable of proof, of the statements which his rude verses contain. Mr. Thoms had searches instituted in the Diocesan records at Hereford, and made numberless efforts, by means of direct enquiries and advertisements, to obtain some fragment of substantiation ; but no corroborative information could be elicited beyond the entry of his year of death. The Registers of Alderbury contain no mention of him. The record of Parr's age, Mr. Thoms has no difficulty in showing, rests exclusively, as in the case of Jenkins, upon the man's own unsupported personal assertions.

I refer to the post-mortem examination by William Harvey,—which has been so frequently adduced in evidence (*e.g.*, by Haller, in his "*Elementa Physiologiæ*," by Flourens in his *Treatise on Longevity*, by Hufeland, and others), as though Harvey had testified to the age itself,—in a subsequent paragraph†: this record I have carefully examined, and I there describe its contents.

Parr, therefore, may be relegated, with Jenkins, without the faintest misgiving, to the voluminous roll of reputed Centenarians in excess which common rumour and the popular love of the marvellous have produced.

Catherine, Countess of Desmond, daughter of Sir John Fitzgerald, and wife of the Earl of Desmond, is reported to have attained the age of 140 at her death in 1604. Mr. Thoms, as the result of minute enquiry, established the fact that an earlier Countess of that title had

* Usually known as the "Water Poet," on account of his having pursued for many years the occupation of a Waterman on the Thames.

† Page 47.

been confounded with the lady in question, and that, in all probability, about 40 years should in consequence be deducted from her reputed age. Her actual date of birth remains unknown; the allegation of extreme age rests exclusively upon hearsay, and she too may be confidently classed among the popular exaggerations of the past.

Mr. Thoms, I consider, has demonstratively proved that these three palmary and constantly-cited instances of abnormal longevity are not merely based on shadowy and illusory foundations but, tested by the most elementary standards of evidence, are absolutely devoid of the slenderest credibility. As a result of his prolonged investigations, with the application of adequate tests, both of evidence of birth, identity, and death, Mr. Thoms is convinced that, among the general population of this country, he can only consider four instances of Centenarians to be established on a reasonable basis. I now furnish the brief details of these accepted cases.

Mrs. Williams, Dorsetshire, died on the 8th of October 1841 at the age of 102. Her Birth Certificate was discovered in the Register of St. Martin-in-the-fields, from which it appears that she was born on the 13th of November 1739; and it was further ascertained, from a careful examination of the Register, that there could not have been another child of her parents of the same name.

William Plank, of Harrow, was born on the 7th of November 1767; and, at his death on the 19th of November 1867, he had just completed his 100th year. His age has been authenticated by documentary evidence at various periods of his life: for example, there has been discovered his Baptismal Certificate in the Parish records of Wandsworth; his Articles of Indenture as a Calico printer afford affirmatory proof; while the Salters' Company possess an entry of his admission to their Freedom among their archives. He survived his century, therefore, by 12 days.

Jacob William Luning is a well-authenticated instance; and he appears on my list of Centenarians on page 9. Born at Hameloörden, in Hanover, on the 19th of May 1767, he was an inmate for many years of Morden College, Blackheath, and died on the 23rd of June 1870, at the age of 103 years 1 month and a few days. The Certificate of

his Baptism has been examined, and the identity of the child so recorded has been established. It was ascertained also that, at the age of 36, he assured his life in the old Equitable Office ; and, in a letter addressed, on the 9th of April 1872, to Mr. Thoms by Mr. A. H. Bailey, the late Actuary of the London Assurance Corporation, detailing the experience of Life Assurance Companies in respect of longevity, Mr. Bailey mentioned the case of Luning, and added that this furnished the sole example of Centenarians in Assurance records, which, moreover, presented only three instances of death in the 99th year of age.

Mr. Thoms failed to discover any authenticated case of Centenarians in any noble family, but in the Baronetage he obtained an undoubted example.

Catherine, daughter of Sir John Eden, of Windleston, who married in 1803 Robert Eden Duncombe Shafto, M.P. for the City of Durham, died on the 19th of March 1872 at the age of 101 years, 1 month, and 9 days. Her Baptismal Certificate (preserved in the records of the parish of St. Andrew, Auckland, Durham), shows that she was baptised on the 11th of February 1771. Her identity also was clearly established. Sir Alexander Spearman, of the National Debt Office, informed Mr. Thoms, on the 18th of April 1872, that Mrs. Shafto appears, from the records of the Tontine of 1789, to have been aged 19 in October 1790, when the nominees were constituted ; that neither she nor her family possessed any interest in the Tontine ; that she was a nominee selected by the Lords of the Treasury for the purpose of maintaining the complete number of lives ; that the lives appointed by the Treasury were the children of peers, baronets, and other persons, who could be readily traced during their lifetime ; that her age and identity had been approved, first by the Exchequer, and, since 1832, by the Commissioners, continuously and exactly to her death. Sir A. Spearman also mentioned that the experience of the National Debt Office certainly contained the record of one other life that had existed for upwards of 102 years, namely, that of David Rennie, a farmer of Dundee, who was born on the 28th of February 1755 and died on the 2nd of March 1857,—the evidence in the case being conclusive.

It may be added that, in a letter, dated the 31st of October 1870, and addressed to Mr. Thoms, Sir T. Duffus Hardy, of the Public Record Office, stated that he had examined the subject of longevity during the 13th, 14th, 15th, and 16th centuries, and had arrived at the conclusion that 70 years was then considered to be a great age, which few attained. He had obtained his data from the *Inquisitiones post mortem*, and from the records of the examination of witnesses in Chancery suits, and other sources, which, however, were not always to be trusted. His own belief, based upon our National records, was that persons, whether in the higher or lower orders of Society, seldom reached the age of 80; and he remarked that he had never discovered an instance beyond that age which could be regarded as trustworthy during the centuries specified.

To complete the statement of the laborious researches of Mr. Thoms, I may mention that he furnishes the following cases as possibly, and some of them probably, genuine, though the evidence is not adequate; indeed, it is entirely deficient in respect of establishing the identity of the alleged Centenarian with the child named in the entry of Baptism: Mrs. Lawrence, reported to have been born on the 9th of August 1758, and to have died on the 17th of February 1862, at the age of 103 years, 6 months, and 7 days; Sally Clark, said to have been born in 1762, and to have died on the 21st of April 1871; Peggy Longmire, born on the 17th of April 1765 and died on the 30th of May 1868, aged 103 years and 6 weeks; and Mrs. Puckle, born on the 13th of September 1767, baptised on the 13th of September 1767, and died on the 9th of December 1872, in her 106th year.

Mr. Thoms, in reviewing his investigations, concludes with the significant statement, in relation to the extreme difficulty of proof, that reputed Centenarians, with scanty exceptions, are exclusively found among the poorer classes of society which generally possess no family papers; frequently no family Bible or Register where the births of the children are recorded; so that satisfactory identification is always precarious and, frequently, impracticable; and, accordingly, in these instances, the Register of Baptism is the sole mode of evidence and provides the most fallible source of proof in the absence of

corroborative documentary facts. Extreme longevity in the majority of cases is dependent entirely upon the unattested affirmation of the Centenarians themselves.

- ii. We have now to consider the work of an able French savant, M. J. Pierre Flourens, Perpetual Secretary to the Academy of Sciences of Paris, and Professor of Comparative Physiology at the Museum of Natural History, Paris. His Treatise* was translated from the 2nd French Edition, and was issued in England, in 1855, by Mr. Charles Martel.

This Book is eminently deserving of careful perusal, both on account of the distinguished scientific position and extensive researches of the specialist, and by reason also of its temperate, lucid, and agreeable literary style, the breadth of philosophic spirit it displays, and the evident and supreme concern for Truth by which the author is animated.

He commences by citing the life, and expounding the Treatise, (*Discorsi della Vita sobria*) of Luigi Cornaro, a member of an illustrious family of Venice, who died on the 26th of April 1566. The precise date of his birth is unknown, so that according to some accounts he barely failed to reach the Centenarian stage, while other records affirm that his age at death was 105.

The figure of Cornaro, there described, is, to a student of human history in any exalted mood, a mournful and depressing one: a man who, in his strenuous efforts to obtain long life, largely failed to live in any impassioned or sustained mode: one who sacrificed all the nobler forms and possibilities of existence in order to secure the minor, and, in view of the dignity of human character, the degenerate end of extent of days. The primary care of man, with this quest in sight, is stated to consist, not merely in the patient and persistent observance of sanitary laws, but, especially, in the avoidance of every form of sadness; the spectacle and reminiscences of sorrow are to be resolutely banished from the vision and memory, with all the gracious and humanising ministrations which personal and sympathetic grief

* On Human Longevity, and the Amount of Life upon the Globe (*De la Longévité Humaine*).

and troubled experiences conspire in constituting the significance and reality of a disciplined and benignant life. Brevity of days may well be eagerly desired if length of age is to be won at the cost of sympathy with the fears and yearnings of mankind, and the suppression of those inspiring spiritual longings and perplexities, born of unrest and yet of restless hope, upon which alone a genuine scheme of life can be profoundly and authentically based.

In our author's judgment, the certainty of Parr's age is impossible of dispute, and he expressly founds this conclusion upon the supposed testimony afforded by Harvey's post-mortem examination.*

M. Flourens appears to accept the instances of longevity mentioned by Haller (and contained in the *Adversaria* which I have furnished on page 45), and adds that his own physiological researches prove that the normal term of duration of human life may be assigned at 100 years. Divine Providence, he concludes, as these investigations indicate, intended that man should attain universally that limit of age.

In earlier enquiries,—and this remark is not confined to the present subject, but is incident to physical speculation generally in its pre-scientific stages,—it is observable how prompt is the conception that an apparent uniformity in the coexistences and sequences of phenomena constitutes an objective expression of a Divine Idea. I am entirely disposed, accepting the noble heritage of physical generalisations which science has deciphered, and enshrined in the Statute Book of Natural Law, to admit this teaching, where the induction is sufficiently extensive; the elucidated principle adequately luminous and distinct; and where the processes of investigation, analysis, and, especially, of verification, have been efficiently applied. I cannot indeed avoid thinking that general Physical Science, which must necessarily present an aspect towards the Supersensual, may reach hereafter an apotheosis in a revival of the Platonic Doctrine† that the Divine Ideas exist subjectively as archetypes in the Original Mind; find their natural expression in the form of laws or uniformities

* After stating that even the "timid" Haller accepted Parr's age as genuine, he adds "*et qui l'est en effet, car il eut pour témoin Harvey.*"

† Dr. W. Thomson : *An Outline of the Necessary Laws of Thought* : Introduction.

embodied in the material Universe; and finally gain an intellectual home once more in the kindred human mind,—kindred in nature, though infinitely inferior in degree, to the Divine,—in the shape of scientific propositions collected from observation and experiment. “Quod in Naturâ naturatâ lex, in Naturâ naturante idea, dicitur.” The notion of M. Flourens accordingly is in itself a legitimate one as a *general* suggestion, but certainly in many instances, and obviously in enquiries of the character which we are considering, the inference is not justified by an adequate range or minuteness or confirmation of research.

- iii. Mr. Joel Pinney, in 1856, published a Volume upon this subject.*

Instances of longevity are not recorded; and the only interest in the Book relates to the duration of life in Patriarchal times, so that I reserve his speculations for the ensuing Chapter IV.

The work is temperately and earnestly written, but, beyond the utterance of the author's undemonstrated judgments, it furnishes no aid in our investigation.

- iv. The well-known physician, Sir Henry Holland, was the author of an Essay upon Human Longevity† where,—while considering as unproved the case of Henry Jenkins, and doubtfully regarding the advanced age of the Countess of Desmond,—he expressed his inability to reject the evidence furnished respecting the longevity of Parr; and he specifically based this judgment upon the assumption that the age was accredited by the testimony of Harvey as a result of his examination of the body after death.

I refer more particularly hereafter to the Memorandum of Harvey, which I have carefully studied; but, apart from the fact that it in no degree certifies to the age as a personal judgment, I need not point out that the most eminent physiologist, from a mere inspection

* The Duration of Human Life and its Three Eras; when Men attained to more than 900 years of life; when they attained to only 450; when they reached to but 70.

† The *Edinburgh Review* for January 1857.

of the viscera, could pronounce no specific or valid opinion upon the attained number of years, but could only adjudge that the physical condition of the internal organs indicated, in a general way, an advanced age.

Sir Henry then adds, *ex cathedrâ*, that adequate proof existed of the frequent prolongation of life to periods of 110, 130, or 140 years, but without in any manner producing the instances, or indicating in the remotest degree any mode and application of proof. His statement, therefore, is entitled to no superior credence to those which are solely based upon a feeling of wonder; a belief in the persistent power of the human constitution; and upon popular and unattested report.

- v. Sir George Cornwall Lewis was distinguished in many departments of knowledge and research; a sound and practical Chancellor of the Exchequer; an able Statesman; a philosophic student of the Methods of Historical enquiry as exhibited in his "Astronomy of the Ancients"; and particularly as a competent successor of Niebuhr in the critical spirit of Investigation, of which Niebuhr laid the foundations in his "Römische Geschichte," and which Lewis successfully continued in his "Enquiry into the Credibility of Early Roman History." Sir George Lewis, besides eminently possessing the critical faculty, disciplined and rendered practical by his patient examination of Ancient History, displayed in a high degree the judicial and impartial tone of mind. Hence his statements upon our subject are entitled to the most respectful attention. In a contribution upon Centenarians,* he remarked that, limiting our survey to the period which had elapsed since the Christian epoch, it might be affirmed as a fact that no person of regal or noble rank mentioned in history, whose birth was recorded at the date of its occurrence, had attained the age of 100; and combining this result with the circumstance that no authenticated instance of a life exceeding 100 years had

* *Notes and Queries*: 3rd Series: Vol. i.: for the 12th of April 1862.

been discovered in the experience of Assurance Companies, he considered that a distinct presumption was established that human life, under its existing conditions, was never prolonged beyond that term. He then laid down the appropriate canons of evidence ; the dates of birth and death, attested by documentary proof, and especially the vital settlement of identity ; and mentioned that he had personally investigated many alleged cases of life extending beyond 100 years, but had invariably found it to be difficult to obtain adequate corroboration.

In reply to the customary argument that excessive longevity is simply analogous to other ascertained peculiarities of human physiology, as exhibited in giants and dwarfs, extraordinarily fat men and men of "extreme tenuity," he pointed out that, although an abnormally extended duration of life would not appear *à priori* to be inconsistent with the laws of Nature, the essential *differentia* between these related cases consisted in the fact that excessive height and weight, and their opposites, are affirmed by the indubitable evidence of eye-witnesses, while, in respect of extreme longevity, there is no record in published books of any existence prolonged beyond 100 years under the prevailing conditions of our physical constitution.

He concluded, however, by stating that he had recently discovered an instance where the term of 100 years was exceeded, in which the proof was authentic and beyond doubt : that of Mrs. Esther Strike, who was buried on the 22nd February 1862, where the private baptism took place on the 3rd of June 1759, and the public baptism on the 26th of that month, so that she had reached her 103rd year. He adds that he had inspected the certified extracts from the Registers ; but he does not refer to the equally important element of identity, which was the more necessary inasmuch as she had changed her name by marriage.

- vi. The eminent statistician, Dr. Wm. Farr,* of the General Register Office, has furnished the following Table of persons

* Census Report: 1871.

returned at the Census as having attained the age of 100 and upwards :

Census			Number
1821	...	...	216
1841	...	...	249
1851	...	...	215
1861	...	...	201
1871	...	...	160

And, of the total of 1,041, 716 were females.

To complete the comparison, it may be added that the population was, roundly, 21,000,000 in 1821 ; 27,000,000 in 1841 ; 28,000,000 in 1851 ; 29,000,000 in 1861 ; and 31,000,000 in 1871.

Dr. Farr* stated that he perceived no reason to doubt that some of the inhabitants of Great Britain had lived a century ; and that, consequently, the period of 100 years might be considered the circuit of time in which human life proceeded through all the phases of its evolution.

I have submitted a few remarks upon Population Tables, when describing the formation of Dr. Farr's English Life Table on page 50.

- vii. Mr. Cornelius Walford,† a well-known and industrious writer on Statistics, compiled a list of persons, 218 in number, who had attained the age of 120 and upwards ; collected, he stated, from various "authentic" sources. The ages range from 120 to 207 ; the earliest date of death in any instance is 1588 ; and the examples are apparently scattered over every region of the globe. Among these curiosities of credulity appear Jenkins, Parr, and the Countess of Desmond ; a Negress who is said to have died in 1780 at Tucuman, South America, at the age of 175 ; an Ethiopian, whose age at death was 150 ; a black man at Jamaica of the age of 140 ; a representative from Poland, and the Russian peasantry ; all are adduced as equally trustworthy, with the briefest

* Census Report : 1851.

† *The Insurance Guide and Hand-Book* : 2nd edition ; Appendix to chap. vii.

particulars, frequently without the date of death; and in no instance accompanied by even the scantiest, or most exiguous, evidence.

The meaning of the term "authentic" must be polarly reversed if we are to attach the faintest credibility to this heterogeneous and fabulous collection.

viii. Mr. John Burn Bailey discussed the question in 1888 in an interesting Volume.*

The work is written in a pleasing style, and contains the history of St. Anthony the Great; Luigi Cornaro; Titian, the painter; Fontenelle (the author of "Entrétiens sur la Pluralité des Mondes," which formed the precursor of the speculations of Whewell in the "Plurality of Worlds"; Sir David Brewster's "More Worlds than One"; and R. A. Proctor's "Other Worlds than Ours"); Caroline Herschel, daughter of the great Prophet (employing the word both in its specific and its popular sense) of Observational Astronomy, and sister of the illustrious Sir John Herschel; Mrs. Somerville, the wonder of her sex in the Mathematical world, of whom the famous Laplace declared that she alone among women comprehended his "Mécanique Céleste"; and Sir Moses Montefiore.

After a brief résumé of the investigations of Mr. Thoms, Mr. Bailey adduces a group of "unquestionable Centenarians," whose records have been examined since the work of Mr. Thoms appeared. They are:

Miss Agnes Baillie,—the eldest sister of the more widely known authoress, Miss Joanna Baillie,—whose mother was the sister of the eminent anatomists, John and William Hunter. Mr. Bailey finds that she died on the 27th of April 1860; her date of birth is not furnished, but she is reputed to have attained the age of 100.

Lady Smith, of Lowestoft, whose husband was the founder of the Linnean Society. Mr. Bailey states that the entry in her Baptismal Certificate, and a record in the Family Bible made by her father at

* Modern Methuselahs, or Short Biographical Sketches of a few advanced Nonagenarians or actual Centenarians, who were distinguished in Art, Science, Literature, or Philanthropy.

the time of birth on the 14th of May 1773, have been found to coincide; she died on the 3rd of February 1877, at the age of 104. The Revd. Canon Frederick Beadon, born on the 6th of December 1777, and died on the 10th of June 1879, at the age of 102. It is stated that he was ordained at the earliest canonical age.

Miss Hastings, one of whose brothers was the founder of the British Medical Association, was born on the 14th of March 1782, and died on the 12th of March 1886, at the age of 104. Mr. Bailey remarks that these facts were properly certified: Dr. Humphry, who contributed the record to the *British Medical Journal*, reported that he had inspected the entry of her date of birth in the Family Bible.

No detailed evidence is furnished in any of these cases; but, looking to the social position of the persons, and the comparative facility of verification, I perceive no ground for doubt respecting the trustworthiness of the statements. The instance of Lady Smith, I may mention, was well known, and apparently duly attested. It is a misfortune, however, that Mr. Bailey did not specify the minute evidence in each example of the date of birth and identity.

Mr. Bailey includes a chapter, without the production of any proof, on 10 additional cases of "recent and probable Centenarians."

To recapitulate, in the instance of Miss Hastings, the elements of longevity, which Dr. Humphry adduced as a general conclusion in the work I have described on page 38, he mentions that she presented typically the conditions of derivation from a long-lived and healthy ancestry; was an excellent sleeper; possessed a vigorous constitution; sound and equably balanced organs; a good appetite and digestion; was a fairly early riser; a moderate eater of meat; taking but little alcohol; gifted with superior intellectual ability, and mental activity and resources; endowed with a spare frame; energetic in habits; aided by regular action of the bowels; blessed with a happy disposition; enjoying sound health, with a reasonable amount of outdoor exercise; dowered with distinctive capacity of recovery from severe illnesses; and only succumbing, therefore, to the orderly and gradual developmental processes by which the natural termination of life is produced.

Mr. Bailey adds that no more prominent fact had been elicited from his own inquiries than the observation that the mentally deficient or intellectually inactive fail to be represented in his list of the long-lived ; energy of brain must coexist with vigour of body to ensure extreme longevity. And he quotes the distinguished physician, Sir Benjamin Brodie, to the effect that the failure of the mind in old age is frequently less the result of actual physical decay than that of disease ; ambition, in advanced life, has ceased to inspire and impel ; contentment has produced lethargy ; indolence is accompanied by degeneration of mental power, ennui, and sometimes speedy death. Men have been known to die, literally speaking, of disease induced by intellectual torpidity and vacuity.

This conclusion of Sir B. Brodie, I consider, is undoubtedly true in a general sense ; we constantly find, in the experience of commercial societies, that men, who have pursued an energetic intellectual or practical life in the administration of business affairs, frequently disappear very speedily after their retirement from active work. This, I have adequate reason to affirm, is largely due to the circumstance that, during their period of vigorous exercise and concentration of faculty in one particular and absorbing direction, they failed to cultivate the higher powers of the mind in Literature, Art, Science, or Social enterprise, and hence, when the strain of activity has relaxed, they possess no intellectual, æsthetic, or other available channels into which the modified capacity and interest can be discharged. It is a truism to enforce the doctrine that if, on the cessation of the primary labour of life, a human being desires to enjoy a prolonged and prosperous existence, he must, in his earlier career, have provided by study, external to his customary toil, various avenues of mental and moral energy in which the remnants of his activities may congenially persist. The very conception of an organism, as a unity composed, not of mechanically connected but of vitally interdependent parts, implies the condition that atrophy, at whatever point originating, must necessarily expand and pervade the whole. The preceding conclusion is not universal, for many instances of longevity occur in the humbler classes of life where intellectual power has not been displayed, and, in these examples, I apprehend that the vital

persistency is aided by absence of the abstraction of any portion of the total constituent force into mental regions. In the period of growth, and in the maturity of life, a drain of energy from one section of the system,—and, in the present condition of physiology, our language on these subjects must to an extent be figurative, without any implication of the source or nature of physical or vital force,—produces an enlarged exhibition of power in the other regions to which it is transferred, while still efficiently maintaining the adequate vigour of the depleted department in a healthy mode; but when the total supply of energy has become reduced in age, a diminution in one quarter is coincident with local degenerative change. It appears probable, therefore, that these two seemingly opposed explanations point to the difference in original and uniform mental activity of the two sets of individuals compared.

- ix. A most admirable record of patient investigation was published in 1889 by Dr. G. M. Humphry, F.R.S., Professor of Surgery in the University of Cambridge.*

It appears that, at his suggestion, a Collective Investigation Committee of Medical Men (Members of the British Medical Association) prepared, in 1884, a Circular of Enquiries addressed to the Profession, dealing, *inter alia*, with the subject of Old Age; and accompanied by schedules which were to be completed under the supervision of the Practitioners themselves. The results were then tabulated by Dr. Humphry, and are presented in his Volume.

The information comprised the social condition of the old people, and their past history; their power of digestion; the extent of their appetite; whether they were large or small eaters; the amount of alcohol they consumed; the quantity of animal food they ate per day; their natural disposition, placid, irritable, or energetic; the regular action of their bowels; the times of going to bed and rising; their capacity for sleep; the amount of outdoor exercise taken; and, as regards their past history, the number of children born to them; whether they themselves were the first or subsequent child of their parents; their previous ailments of an ordinary or special character;

* Old Age.

their habits; and the condition of health and duration of life of their parents.

About 900 Returns were obtained, and most laboriously analysed and tabulated by Dr. Humphry. The statistics were divided into those relating to males and females; and were then subdivided into separate Tables, for each sex, of persons who were then between 80 and 90 years of age; between 90 and 100; and those exceeding 100. I restrict myself to the results exhibited in the last category. These Returns comprised 52 alleged Centenarians, composed of 16 men and 36 women; in 11 cases (2 males and 9 females),—of whom one had attained the age of 108, and another, 106,—Dr. Humphry mentions that the age was proved by the Baptismal Certificate or some other record. In the remaining instances, uncertainty exists upon the age, but Dr. Humphry suggests that the statements generally may be reasonably received since the Returns were compiled under the supervision of Medical Men who believed the recorded ages to be correct, or who were acquainted personally in many cases with the persons respecting whom the particulars were supplied. I entertain a sincere admiration for the Medical Profession; but, apart from the extreme difficulty, which would necessarily be inherent in securing satisfactory evidence of age and identity in respect of persons drawn largely from the poorer classes of society as these were, I unhappily feel quite unable to accept, after careful study, the trustworthiness of ages based upon the declarants' personal authority without the collateral support of an exhaustive and troublesome individual application of the customary tests. The question does not consist in the good faith of the Doctors or their patients; that *uberrima fides* I willingly accord to their rejection of whatever appeared to be untrue or exaggerated; the difficulty rests in the *generality* of the procedure they were unavoidably compelled to adopt in this investigation, and the practical impossibility, in so extensive and miscellaneous an assemblage of facts, of applying stringent rules for verifying the assigned age. Moreover, even in the selected 11, Dr. Humphry does not refer to the essential element of identification. And it is obvious that the intricacy of identifying the reported Centenarian with the child named in the Baptismal Certificate (and additionally so in the case

of a married woman where the name has been changed), is enhanced at each further stage in the duration of life. Where a Table expressive of the rate of mortality is formed on an ample basis, errors in the ages furnished may be justly conceived to balance each other—excess against deficiency,—but in any inquiry, like the present, the paramount requirement is the precise settlement of the age of the *individual* person.

Summarising the results appertaining to the assumed Centenarians, Dr. Humphry reports that

- (i.) of the 36 women, 26 had married, and 11 had had large families; many of the Centenarians were members of large families, averaging 7 or 8;
- (ii.) 12 were the first children of their parents: a fact which does not accord with the prevalent notion that first children generally exhibit a physical disadvantage in the struggle of life;
- (iii.) the majority were moderate or small eaters; proving the fallacy of the popular belief that strength is proportionate to the amount of food;
- (iv.) the greater number, again, took but little animal food or alcohol,—12 of them being teetotallers either for life or for lengthy periods; a fact which Dr. Humphry considers to be in harmony with the lowered activity of the muscular system and organs, and the consequently reduced demand on the nutritive processes and the nutritive supply—this diminished drain and less rapid consumption of energy conducing to longevity;
- (v.) the majority had experienced few illnesses during their lifetime, though the detailed facts disclosed in the schedules proved that the occurrence of even severe maladies was consistent with the attainment of extreme age;
- (vi.) And as a rule the records showed that outdoor exercise and early rising constituted important factors.

- (vii.) The average age attained was $102\frac{1}{8}$ years;
- (viii.) Eleven of the examples were single, of whom the females numbered 10;
- (ix.) Among other features may be briefly mentioned that, out of 26 Returns, 14 were of a placid disposition, while 5 were irritable and energetic; the average number of hours spent in bed was $8\frac{1}{2}$; and 32 out of 44 persons were excellent sleepers;
- (x.) It is noteworthy, if dependence (which I doubt) can be placed upon the uniformity of the standard of efficiency, that, out of 47 Returns, the digestion was reported to be sound in 40 instances; while, out of 45 Returns, it was ascertained that the whole number had enjoyed vigorous health during their past history;
- (xi.) In 50 Returns, the number of persons who lived in comfortable circumstances, neither affluent nor poor, was 28; 36 out of 48 possessed excellent appetites; the moderate eaters were 25 in 46; those who drank little or no alcohol were 39 out of 46; the quantity of animal food consumed was small in 40 instances out of 41; while 12 (out of 38 Returns) were the 1st children of their parents,—the average of the whole number being the 3rd child. It appears also that the larger proportion of all the examples, ranging from 80 to 100 years of age, were reported to belong to long-lived families, thus testifying to the serviceable aid of hereditary predisposition.

Dr. Humphry adds the interesting physiological fact, as an element of prolonged life, that the elasticity of the thorax as exhibited by the condition of the costal cartilages, and its capacity of dilatation during inspiration, was more markedly pronounced in the female patients.

And he sums up the prominent qualities tending to old age; sound family history; a well-made frame of average stature,—5 feet 8 in males, and 5 feet 3 in females; a spare habit; continuous good

health; a vigorous digestion; the regular daily action of the bowels; reasonable muscular activity and its exercise; the capacity of sound sleep; early rising; a good appetite, moderately indulged; little alcohol or animal food; and a placid temperament.

While cordially admiring this patient, exhaustive, and instructive enquiry, I fear I must definitely express the judgment that, while the facts relating to the physical and personal conditions of longevity can be generally accepted, the reputed ages cannot in any degree be confidently included in the list of approved and verified statistics, on account of the difficulty of deciding that the tests, though honestly and scrupulously attempted, were rigorously, or even approximately, fulfilled.

I trust it will not be regarded as detracting from the dignity of the subject if, referring to one of the elements in the preceding statements, I emphasise the fact, as an observant layman, that a most serious physiological defect in our training of the young lies in the absence of attention to the regular periodicity of the action of the bowels. If, in childhood and early youth, children were habitually accustomed, as an essential part of their mechanical routine of life, to assign approximately a *specified* point of time to this function, the constitution would steadily and permanently adjust itself to the hour; fixed recurrence of time would synchronise with natural periodicity of exercise, and the foundation would be securely laid for that persistent regularity of physiological action on which depend so constantly, not simply the prolongation of life, but also, that serenity and effectiveness of mental and moral character as conditioned by the rhythmical and functional activity of the physical processes.

- x. In 1799 Mr. James Easton* issued a Volume in which he accepted as authentic the ages of Jenkins, Parr, and the Countess of Desmond, and expressed the opinion that, by attention to the laws of Nature, man's life might probably be extended to 200 years; though this generalisation, I

* Human Longevity: recording the name of the place of residence, and the year of the decease, of 1,712 persons who attained a century and upwards, from A.D. 66 to 1799, comprising a period of 1,733 years.

may add, is based exclusively upon the autopsy of Parr by Harvey.

It is an obvious remark, suggested by this statement, that a course of elementary training in the modes of evidence required in physical Science should form the indispensable equipment of every enquirer into the subject, for, in almost no other department of research, are the examples more numerous of general propositions deduced, not from an adequate induction of facts, but resting solely upon a few fragmentary and isolated phenomena of unverified character.

Mr. Easton furnishes the following Table as a summary of the instances of longevity among males and females which he had collected:—

The Persons who Lived between the stated Ages, both inclusive,	Numbered
100 to 110	1,310
110 to 120	277
120 to 130	84
130 to 140	26
140 to 150	7
150 to 160	3
160 to 170	2
170 to 185	3
	1,712

And he observes that he had refused admission to the roll of all cases where he entertained the slightest doubt of their authenticity. His standard of evidence appears to have been wonderfully elastic.

He then produces a voluminous and detailed record, comprising the name of every alleged Centenarian, with whatever particulars he had been able to collect; gathered from every quarter of the world; and he is careful to remark that from country villages, and not from crowded towns, had the vast majority of his examples been supplied.

It is obvious that the difficulties of discriminative search are indefinitely multiplied when the sources consist of remote districts

and ignorant periods, full of the childish wonder and eager credulity which abnormal longevity invariably excites.

He nowhere deals with the specific question of evidence; in no instance does he cite the authority, if any, on which he relies, nor the mode or extent of any investigation, if any, which he may have instituted. His laborious and miscellaneous repository, accordingly, is as unsubstantial and irrelevant, so far as proof is concerned, as the universal generalisation of the possibility of advanced age which he deduced from two or three uncorroborated and isolated specimens.

In Appendix No. IV. to a work published by the eminent mathematician, Mr. Charles Babbage,* in 1826, a Table of Mortality is presented which is formed from a collection of 1,751 persons who had attained the age of 100 and upwards. The greater portion of the so-called facts are selected from Easton's book, while some few instances, enumerated by Easton, are excluded by Mr. Babbage on account of their double occurrence or of possessing doubtful authority: some additions were inserted by Mr. Babbage himself from other sources. It would be interesting to discover the method which Mr. Babbage employed for discriminating between the dubious and assumed authentic examples in Easton's heterogeneous and fabulous schedules. Nothing in Easton's work indicates in any degree the suggestion of a mode on which this selection could be based. Mr. Babbage's Table, therefore, is purely hypothetical and valueless. He adds the instructive remark that a disproportionate number of deaths appeared to cluster about the round numbers of ages 110, 120, 130; and Dr. William Farr,† I notice, refers to the partiality of the public, in the registration of deaths, for mentioning "round figures."

Mr. Babbage assumed 150 as the limiting age, although he concludes by stating that there were two or three "authentic instances" of persons of even more advanced years, without, however, affording any reason or proof for this statement or surmise.

* A Comparative View of the Various Institutions for the Assurance of Lives.

† The Second Annual Report of the Registrar-General.

- xi. The celebrated physiologist, Albert Haller—"in *Senatu supremo Bernensi ducentum viro*,"—issued a Treatise* in nine octavo volumes at Berne in 1766. I extract my citations from the 8th Volume; Pars Secunda: Lib. xxx., under the sub-title of "Vita Humana et Mors."

The work is written in Latin, but, happily for a slow reader of that language like myself, the composition makes no pretension to classical style.

He accepts the age of Parr upon the basis of Harvey's "libellum"; and considers that the advanced age of Jenkins is "satis probabiliter."

He adduces, without any attempt at evidence, from various authors, ancient and modern, the attained ages of 105, 109 (mentioned in the *London Magazine* for 1763), 110, 112, 115, 117, 121 (recorded in the *London Chronicle* for 1759), and 130. And among these so-called facts, he points out (in his chapter on "Causæ quæ vitæ terminum abbreviunt") that the London Bills of Mortality in 1751 (published in the *London Magazine* for 1762) show that, out of 21,028 deaths in London, there was one Centenarian out of 1,617; while, in the year 1754, one person out of 22,696 deaths recorded in London, had attained the age of 109.

From his *Adversaria*, or Commonplace Books, he extracts a record, without any indication of proof or sources, and apparently founded on hearsay only, that

between the ages of	there were
100 and 110 . . .	upwards of 1,000 men ;
110 and 120 . . .	about 62 ;
120 and 130 . . .	29 ;
130 and 140 . . .	about 15 ;

while, between the ages of 140 and 150, the enquirer enters upon a mythical period. And especially he cites the cases of D. Eccleston, who reached 143 (reported in the Philosophical Transactions of our

* *Elementa Physiologiæ Corporis Humani.*

Royal Society), and of Jonathan Effingham, who died at 144 as stated in the *London Evening Post* of that time.

In referring to British illustrations of longevity, he complimentarily appears to consider their larger proportionate number, compared with the experience of other countries, to arise "per suas leges felice"; and in another section of his work, entitled, "Regiones longœvæ," he pays England and Ireland the additional compliment of "Anglia et Hibernia supra omnes pene regiones in Longœvorum numero videnter eminere."

He collects, from ancient and modern sources, instances of the attained ages of 150, 172, 175, 185, 190, 240, 260, one from Pliny of 300, and another of 340.

But as I have stated the catalogue is one simply of curiosity and unverified research, for no investigation apparently was made, nor indeed could be attempted, into the question of proof. The cases belong entirely to the apocryphal portion of our story. Haller had observed the superior vitality of females, and remarks on this point, "Inter sexus, fœminæ quidem non satis paucae ex puerperis periunt mensumve anomaliis. Quando horum periculorum ætatem superaverunt, plerumque ultra virorum annos edurant. Molles fibres tardius credas indurari."

- xii. The "Art of Prolonging Life,"* by Christopher William Hufeland, Professor of Medicine in the University of Jena, was published in 1796; translated into English in 1797; and finally edited, in 1853, by Erasmus Wilson, F.R.S., an eminent surgeon.

I shall refer more particularly to this work in a subsequent chapter; here I am solely concerned with the result of any enquiries he independently made in the subject. He refers, approvingly but without any examination of evidence, to the reputed 157 years of Epimenides, a poet and priest of Crete: (other traditions assign him a lifetime of 299 years); to Gorgias of Leontum, the orator, who is said to have lived to the age of 108; to Democritus, the "laughing"

* "Makrabiôtik, or the Art of Prolonging Life."

Philosopher, the teacher of the Atomic System of Nature, who lived to 139; to the founder of the Stoic School of Ethics, Zeno, with his assumed 100 years; to Terentia, the wife of Cicero, who surmounted the torments of gout by reaching the age of 103; to the 105 years of St. Anthony, and the 113 of Paul the Hermit; to the Roman Actress, Luceja, who appeared on the stage in her 112th year; to the records of Pliny, the Naturalist, who relates that, according to the Census which occurred in the reign of Vespasian,—the 76th year of the Christian era,—there were living in Italy, between the Apennines and the Po alone, 124 men who had attained the age of 100 and upwards; the 17 ages recorded in Parma, Faventum, and Vellejacium, ranging from 110 to 132*; and Hufeland accepts, without hesitation, the instances of Jenkins and Parr. He specifically mentions, with particulars, the death of J. Effingham, of Cornwall, in 1757 at the age of 144, and of several others whose reputed ages were stated at 103, 104, 105, 108, 109, 110, 111, 112, 114, 118, 121, 130, 140, 146, and 150. He omits, he observes, persons of 100 years for “these are more common;” and especially cites Hippocrates, one of the founders of Medicine, who died at the age of 109.

It need not be added that, accepted on the sole basis of popular rumour, the contribution of Hufeland to our subject is entirely delusive.

- xiii. The autopsy of Parr, made on the 16th November 1635, by the celebrated physician, William Harvey, is constantly referred to† as corroborative testimony to Parr’s asserted age. The record is published in the Sydenham Society’s Edition of Harvey’s Works, and I have carefully examined it. It commences with the statement, *furnished by the persons who accompanied Parr to London*, that he was born near Winnington, Shropshire (without any mention of the date), and died on the 14th of November, 1635, “after having lived 152 years and nine months.” But this affirmation is not

* Lord Bacon mentioned this Census, and considered it to form an important contribution to the discussion. But there were no Registers of Births in the Roman Empire, and these ages accordingly, even if accurately transmitted, depend exclusively upon the absolutely unverified statements of the aged persons themselves.

† Vide pp. 30 (Flourens); 31 (Holland); 43 (Easton); 45 (Haller); and 47 (Hufeland).

inserted as Harvey's own, but merely as the information supplied to him. He himself simply records, as the result of his post-mortem examination, that Parr appeared to be an "aged individual;" and he then describes the vigorous condition of the viscera. But beyond this, Mr Harvey in no way indicates, even approximately, the apparent age of Parr. The writers I have named have accordingly received an utterly erroneous impression of Harvey's real and simple reference; and it is sufficiently evident that the acumen of the united profession would be incompetent to assess the length of life of a dissected patient even in any reasonably and closely approximate numerical form. At the best, such an estimate could only be accepted as a skilled guess; but Harvey did not even venture to this modest extent.

- xiv. In connexion with their bearing upon the subject of Centenarians, I append a brief history of some of the most prominent Investigations into the Mortality experienced in this country.

The Northampton Table was based by the Rev. Dr. Richard Price,* in 1780, upon the recorded christenings and burials in the town of Northampton during the period of 46 years from 1735 to 1780. The christenings numbered 4,220, and the deaths 4,689. Dr. Price augmented the first term of his Table (age 0) from 4,689 to 11,650, and out of the latter number the highest age attained was 96 years by one person.

It is not relevant to my purpose to describe and explain the erroneous principle on which this Table was constructed (the compilation from the death registrations alone), nor the error involved on the subject of immigration, and the omission from the christenings (with its effect upon the ratios between births and deaths) of the children of dissenting parents.

In 1815, the distinguished Actuary, Mr. Joshua Milne,† published the Carlisle Table of Mortality, founded upon the tabulated statistics

* *Journal of the Institute of Actuaries*: Vol. xviii.

† *Journal of the Institute of Actuaries*: Vol. xxiv.

of the town by Dr. John Heysham between the years 1779 and 1787. The population in the former year was 7,677, and, in the latter, 8,677, while the deaths which occurred during the interval of nine years numbered 1,840. The number of births (or radix) from which the series starts in the actual observations was increased by Mr. Milne, in his final Table, to 10,000. The survivors recorded at the higher ages are 9 at the age of 100; 7 at 101; 5 at 102; and successively diminishing until the last person attained the age of 104. The proportion of females to males was approximately 55 to 45 per cent. This Table was constructed upon the accurate principle of comparing the living and the dead at each age.

The cases of Centenarians here exhibited cannot be depended upon in any degree.

A Committee of Actuaries* published in 1843, the tabulated experience of 17 Life Assurance Companies, comprising 83,905 Policies, with 13,781 deaths. Assuming a radix, or initial term for age 10, out of 100,000 lives, the highest age attained was 99. In the 40,616 cases, where the sex was distinguished, the females numbered 10·3 per cent.

Two well-known Actuaries, Mr. A. H. Bailey and Mr. Archibald Day, presented to the Institute of Actuaries in 1861,† a very admirable and conclusive investigation into the Mortality experience disclosed by the Family records of Peers. The total number of facts comprised in this enquiry was 7,473 (composed of 4,221 males, and 3,252 females), of which the deaths amounted to 3,191. The authors instituted a very careful scrutiny into the question of ages; and adopting, as the starting-point of their Table, the number of 2,534 in the statistics of males, and, in respect of females, the number 2,152, it appears that, in the former series, the last survivor reached the age of 93, while the experience of females contained 2 persons living at 100, of whom one attained the final age of 104.

The authors effectually demolished the conclusion of Dr. Guy, who, by adopting an inappropriate method of construction,—that of

* J. Jones: A New Rate of Mortality amongst Assured Lives.

† On the Rate of Mortality prevailing amongst the Families of the Peerage during the 19th Century. (*Journal of the Institute of Actuaries*: Vol. ix.).

deducing the results from the deaths alone,—had apparently shown that the mean duration of life in the Peerage Families was, in general, materially inferior to that of the male population of the kingdom. By pursuing the scientific course,—that is, expressing at each age the ratio between the numbers actually living and those dying in the succeeding year,—Messrs. Bailey and Day demonstratively proved that the contrary conclusion was irresistibly made evident, and that, for ages under 73, the longevity exhibited by the Peerage males was superior to that prevailing in the general population, while, at the older ages, it practically coincided with that of the selected lives of the ancient "Equitable" Society's experience.

The Institute of Actuaries, in 1869, compiled a series of statistics derived from the mortality experience, terminating in 1863, of 20 Assurance Companies, which comprised (*inter alia*) 146,847 healthy lives, and included 23,856 deaths,—the years of life observed being 1,444,451. The proportion of females was 11·3 per cent. I omit the record of "under average" lives. Out of a commencing number, at age 10, of 10,000, five were shown to have survived the age of 98.

In 1864, Dr. William Farr* produced the results of a laborious investigation in the form of a Mortality Table based upon the Population at the Census of 1841 (15,929,492); the Population at 1851 (17,982,849), and the deaths, numbering 6,470,720, which occurred in the 17 years between 1838 and 1854. This record is usually designated the English Life Table No. III, in contradistinction to two previous enquiries which Dr. Farr had instituted in 1843 and 1863. Adopting a radix of 511,745 in respect of males, and 488,255 in regard to females, it was shown that, of the males, 79 attained 100; 46, 101; 25, 102; until the last survivor reached 107; while, of the females, 144 remained at the age of 100; 85 at 101; 49 at 102; and gradually diminishing until one person died after the age of 108.

I do not consider that dependence can be placed upon the numbers at the advanced ages. I do not assert that some instances of excessive longevity may not be authentic, but I desire simply to indicate the deficient value of the evidence. The ages were obtained

* English Life Table.

from the Census papers, upon the accuracy of which no check whatever exists ; while the reported ages at death are those merely which are mentioned to the Registrars by the several informants whose statements are entirely unsupported by any external testimony. Hence, I attach no value to the statistics relating to Centenarians which this Table presents.

In the compilation of a Table of Mortality from an extensive mass of observations, excesses and deficiencies of age may be expected,—in dependence upon the occurrence of *average* results when ample materials are involved,—to exhibit mutual neutralisation ; but the position is essentially different when our enquiry refers, not to *aggregates*, but to *individual* instances.

In considering the preceding results, it will be noted that a Life Table, or the Presentation of a Succession in Time, is to be distinguished from a Population Table, or the Presentation of a Coexistence in Time. Selecting Dr. Farr's Mortality Roll as an example, the observations do not imply that 79 persons existed at the age of 100, and that the number of 25 were simultaneously living at 102, but that the persons who reached the latter age represented the survivors of the 79, and similarly with the numbers at more advanced stages.

A necessary caution, again, must be observed, (even where the ages have been verified), in accepting as genuine, in many cases, the recorded numbers of survivors at the higher ages where the assumed radix, or the number born from which the series originates, differs from that actually furnished by the original observations themselves. For the purpose of avoiding minute numbers and decimals, as the survivors successively disappear, and with a view to the suitable application of methods of graduation or adjustment of sequence, the compilers of Mortality Tables determine upon a numerical origin of adequate extent in order to preserve these conditions throughout the entire compass of the series. For example, statistics may show that, out of 2,000 persons born, one has attained the age of 100; but if the radix be arbitrarily enlarged to 20,000 it does not necessarily follow, as a fact of Nature, that the Centenarians will amount to 10.

So far as the practical utilisation of the Mortality Table to the purposes of computation is concerned, the radix employed does not modify the *related* facts. The Actuary deals with the *ratios* existing between the numbers living at each age and those dying between that age and its successor; and, when he has obtained these ratios from his actual observations, (purified from the accidental errors common to all collections of facts), and has constructed his amplified Table upon their basis, it is evident that the proportions remain unchanged, and the Table of augmented numbers presents the same inter-relations as those displayed by the original and scrutinised statistics from which it is enlarged. But, for the purpose of our specific survey, caution must be applied; for, as I have mentioned, *non sequitur* that, if a certain number survive to extreme ages as an original record of observations upon a more limited mass of data, therefore a proportionate range of survivance to the limiting age of the Table may be anticipated and accepted when the commencing term is widened. And further, on the other hand, with reference to Assurance and Annuity observations which are terminated at a specific deferred epoch, the survivors to the later ages arise solely from the numbers which remained under survey to the date in question; many, however, of the lives disappear from the subsequent record through the lapse or surrender of their Policies; a considerable proportion, again, continue existing at the terminal point of the enquiry, who are as effectually removed from observation; and, hence, an addition of aged survivors may possibly be included in the numbers who thus successively, at various stages, and, at the final epoch, vanish from the statistician's view.

CHAPTER IV.

THE ALLEGED LONGEVITY OF THE ANTEDILUVIANS.

I.—THE DELUGE.

IN employing the popular term of "Antediluvian," I attach a limitation of meaning, more especially as the views of many previous writers implicitly or explicitly involve the supposition of a Universal Deluge. Indeed, Dr. Thomas Burnet emphasises his contention upon this point by scrupulously observing that the surface of the Globe was covered by water "from pole to pole, and from East to West."* And although it is almost needless, in the present condition of Science, even to refer to the controversy, it may be desirable to assert that all Geological, Astronomical, and Zoological investigation unite in proving that no general Deluge, or even a Flood extending over a very spacious portion of the Earth, has occurred within the past 6,000 or even 60,000 years of our terrestrial story. But, notwithstanding that this concurrent disproof of a Universal or Extensive Deluge has been conclusively established, the tradition of a memorable Flood exists in the primitive records of all branches of the Human Race,† with the sole exception of the Black Communities; and, probably, the most noteworthy is contained in the Fragments of Berosus, a priest of Babylon, who lived about 260 B.C., and particularly and minutely in the Tablets disinterred from the ruins of Nineveh.‡ These copies of Chaldean Tablets were prepared by order of Assurbanipal, King of Assyria, in the 7th century B.C., from the ancient originals preserved in the Library of Erech, a famous town whose foundation dates from the earlier period

* The Sacred Theory of the Earth : Vol. i.

† Cardinal Wiseman : The Connexion between Science and Revealed Religion : Lectures vi. and ix.

‡ George Smith, of the Department of Oriental Antiquities in the British Museum : "The History of Babylonia," Chapter ii.

of the first Chaldean Empire,—a period which transports us anterior to the epoch of Moses. The reader, too, will recall the myth of Deucalion and Pyrrha* in the Grecian mythology.

The Tablets present most interesting and instructive coincidences and precise parallels with the Hebrew tradition contained in the Book of Genesis† or Origins, and testify to the derivation of the belief by all Nations from some common and ancestral legend.

II.—ANTEDILUVIAN AGES.

The unprecedented ages assigned to the Patriarchs of Hebrew story have proved a favourite subject of speculation and explanation ; and, prior to discussing the question on rational, scientific, and historical principles, I purpose furnishing a compendious record of surmises and criticisms upon these alleged phenomena.

It will first be noticed that, antecedent to the Deluge, the ages of the Patriarchs (of which I append a list‡) range, excluding the special instance of Enoch, from 777 to 969 ; that, immediately prior to the Flood, it is stated§ to be a Divine decision that the days of man shall be 120 years ; while, subsequent to that event, they dwindle to 148 ; until we find the anonymous author of the apocryphal Ecclesiasticus|| restricting the extent of individual existence to 100 years ; and the unknown composer of the 90th Psalm¶ asserting the limit to be 70 years. The noble and sympathetic utterances of many of the contributors to the Psalter ; their deep and intuitive perception of the sorrowful experiences of life ; the consecration and appreciation of their profound and permanent presentation of human frailties and needs and griefs and hopes by every responsive and troubled heart ; all these elements,—in spite of an invalid and unspiritual conception of

* G. W. Cox : *A Manual of Mythology* : page 122.

† Chapter vii.

‡ Adam, 930 years ; Seth, 912 ; Enos, 905 ; Keron or Cainan, 910 ; Mehalaleel, 895 ; Jared, 962, (in the Samaritan Text, 847) ; Methuselah, 969, (in the Samaritan Text, 720) ; Lamech, 777 (in the Samaritan Text, 653, and, in the Septuagint Version, 753) ; and Noah, 950.

§ Gen : chap. vi., v. 3.

|| Ecclesiast : chap. xviii., v. 9.

¶ v. 10.

Verbal, Mechanical Inspiration, and indeed of any Theory of Specific Inspiration, which would obscure or superhumanise the speaker's individual Consciousness, or suppress its lapses and limitations, and thus denude his sayings of their impressively human origin and personal appeal,—have prescribed on this point the prevailing notion of a definite average term of "three score years and ten."

III.—VARIOUS HYPOTHESES RELATING TO ANTEDILUVIAN AGES.

- i. Some Commentators,—and the general function of Commentators is to perplex the simple statement and attenuate the plain,—have assumed that the longevity ascribed to the Patriarchs implies that each individual record is simply representative of the combined duration of the prominent members or dynasties of a Tribe or Clan. Though historic parallels may be adduced from other primitive traditions in support of this hypothesis, it is too precarious to be discussed with any definite hope of results.*
- ii. Others have imagined that time was then calculated by lunar years, which would reduce the stated ages in the proportion of about 12 to 1. Dr. Thomas Burnet,† adverting to this supposition, pathetically points out that, if the hypothesis were correct, the interval from the Creation to the Deluge would be lamentably diminished to a little over 127 years. If, urges Whiston,‡ this asserted proportion then prevailed, we should not possess that gradual and gentle decline in the term of existence which the Scriptures proclaim. Augustine§ refers to the assumption that the Hebrew year was one-tenth of our own, and mentions that the younger Pliny, in his "Historia Naturalis," had expressed the opinion that ancient

* *Vide* B. G. Niebuhr. A History of Rome, Vol. i., on the Original Names of Roman Families derived from an heroic *ἥρώωνος*.

† The Sacred Theory of the Earth. Vol. i.

‡ A New Theory of the Earth.

§ De Civitate Dei : xv., 12.

records of extended ages (152 to 300, 500, and even 800 years) were attributable to a mistaken computation. Pliny also asserts that the Arcadians, for example, counted each season as a year, so that their year consisted of three months. The Egyptians, too, Pliny states, reckoned the year at four months, and professed instances of longevity extending to 1,000 years. Augustine contends that the antediluvian year was composed of 12 months, and concludes his objections to all contrary assumptions by exclaiming, in the usual dogmatic mode of professed Theologians,—“Who can away with such foolishness and absurdity?”

- iii. It has been suggested by Hensler and other critics that, from the primeval date of Adam to the period of Abraham, the year employed in the measurement of time comprised only three months; enlarging to eight months from Abraham's epoch to that of Joseph; and continuing from the latter stage at a uniform ratio of 12 months. Although this assumption possesses no reality in attested fact, it is interesting to observe, from the investigation of the most authentic ancient writers upon Roman Antiquities, that the Roman year in the time of Romulus has been shown* to consist only of 10 months, or 304 days,—some of the months containing 20 days; and Numa is stated to have added the months of January and February, and to have constituted a year of 12 lunar months and one day over, or 355 days,—a scale adopted by the Romans in their reckonings until the reform of the Calendar by the Dictator, Cæsar.

Scientific chronology is of comparatively recent origin; arbitrary and varying modes of measurement,—usually unascertainable,—marked the time-relations of primitive peoples to whom precise quantitative rules were of minor importance, and all systematic and co-ordinated knowledge incapable of apprehension. In the evolution of the Race, as in the development of the individual Mind, the conception and steady grasp of natural bonds of connexion between related

* H. G. Liddell : *A History of Rome* : chap. i.

phenomena necessarily form the feature of a later stage of growth. If we can decide, from the recorded data of a people, the numerical value of their primary unit in the computation of time, we are able securely to compare the measures of one period in their history with those of another, assuming that no modification has occurred; in such an examination, we deal with *related* ratios; but in assessing the probability of the arithmetical statements of one age by the standard of another, we must necessarily be assured of an absolute criterion, or of a rule that bears a determinate relationship to that which we employ. The units of mensuration must obviously be identical, or capable of a definite and fixed comparison. Now this indispensable condition is impracticable in the valuation of Patriarchal ages: we possess no sure means of expressing our standard in approximately exact terms of the measure then adopted, since we are entirely unacquainted with its structure.

The parallel instances I have cited of the discrepant modes of calculating the term of the year emphasise the necessity of this criterion. Extreme examples frequently furnish vivid illustrations; and, simply by way of graphic presentation,—for, obviously, the phenomenon itself is practically irrelevant,—I may refer to the length of our general day,—the period of the revolution of the Earth upon its axis,—as affected by Tidal Friction, or the degradation of Rotational Energy produced by the influence of the Tides upon the Earth's surface. Originally, our terrestrial day consisted of 3 or 4 hours only; by successive stages it has become prolonged through tidal retardation to its present duration; in each 1,000 years, its length increases by a small fraction of a second; and, ultimately, it will embrace a compass of 1,400 of our ordinary hours.* Our present difficulty is illustrated by the analogical case of a remote speculator, in comparing his chronology with ours on any specific subject, employing the same term "day," consisting, as it would in his era, of 1,400 hours, and in our times of 24.

* Sir Robert Ball: "Time and Tide: a Romance of the Moon."
 S. Laing's "Modern Science and Modern Thought;" Part I.: chap. ii.; and
 G. H. Darwin: "The Tides and Kindred Phenomena in the Solar System;"
 chap. xvi.

- iv. William Whiston, the successor to Sir Isaac Newton in the Lucasian Professorship of Mathematics in the University of Cambridge, published, in 1696, a *Treatise** upon this subject.

The Edition which I have perused is dated 1708.

Whiston is generally remembered now under the nick-name of "Wicked Will Whiston," conferred upon him by Swift with playful irony in connexion with his expression of Arian opinions which procured his expulsion from the University; for the life of Whiston and of his family was rendered perpetually troubled and unhappy by the exercise of a minutely scrupulous but erratic conscience. John Locke, the founder of Analytic Psychology, it may be noted, commended our author as one of those who, if not adding greatly to our knowledge (a wise reservation), "at least brings some new things to our thoughts."

In passing, I may mention that Whiston advocated a Universal Deluge, which he calculated (for his work is conducted on mathematical and mechanical principles) was produced by a Comet, which, descending in the plane of the Ecliptic towards its perihelion, unluckily happened to come into contact with the Earth at this critical epoch. So precise is Whiston in his mathematical reasoning that he discovered that the first day of the Flood occurred (in our common reckoning) on the 28th of November, 2349 B.C.† The great classical scholar, Bentley, amusingly twitted him with the oversight that, after providing for this voluminous irruption of water, he had failed to devise any mechanism for its subsequent dispersal.

Whiston devoutly accepted the records of longevity of the Antediluvians, and assigned the following reasons in explanation.

The constitution of Man, in this primæval era, was essentially different from that which has since existed, both in the "temper" and

* A New Theory of the Earth.

† An instance of folly only paralleled by the calculation, in the 17th century, of Dr. John Lightfoot, Vice-Chancellor of the University of Cambridge,—an eminent Hebrew scholar of his time,—that the Creation of the World occurred on October the 23rd, 4004 B.C., at "9 o'clock in the morning." (*Vide* "A History of the Warfare of Science and Theology in Christendom," by A. D. White : Vol. i. : chap. i.).

perfection of the soul and in the nature and disposition of the body; the "temper"* of the human material organisation was "more soft and pliable and alterable" than is exhibited in the present degenerate days. This physical condition formed a natural foundation for prolonged life.

The external environment (to employ the modern term as comprising all the exterior conditions of existence) was greatly superior in conducing to length of days; a perpetual equinox, or equality of days and nights, prevailed as a factor of the constitution of the Universe; and this was partly dependent on the fact that the original orbits of the planets, and especially of the Earth, exhibited, prior to the Deluge, the shape of perfect circles: a survival, I may note, of the ancient conception of circularity as indicative of perfection, and accordingly the sole mode of orbital revolution which could appertain to a finished system of the Universe, such as primitive ages were fabled to conceive†: the temperature of the air was warmer and more equable; no sudden or excessive variations of cold and heat occurred; no freezing winters enfeebled the race, for the air being "pure, subtle, and homogeneous" was laden with no gross masses of vapour or clouds or exhalations and "mixtures," producing meteors, thunder, storms, or lightning, with consequent pestilential and contagious infections; and adapted, therefore, to an even and easy progression of life.

The primitive Earth, again, proceeded solely in an annual circuit round the Sun, for the diurnal rotation on its own axis, which now exists, was super-imposed as one of the results of the Deluge, with the vast and attendant differences experienced in the varying seasons of the year. And, as an involved element of these consequences, the

* Archbishop Trench reminds us,—("A Select Glossary of English Words"),—that this term refers to the old physiological doctrine of the "humours"—the humoral pathology—which, in their different mixtures, formed the predominant constitution, consisting of the blood, the choler, the phlegm, and the melancholic (or "black bile"); so that,—("The Study of Words:" Lecture IV.),—the "temper" was the due and harmonious admixture of the several humours.

† *Vide* Whewell: "A History of the Inductive Sciences": Vol. i.: Books i. to iii.; and A. D. White's "History of the Warfare of Science with Theology": Vol. i.: chap. xii.

axis of the Earth has, since the Fall of Man, become oblique to the plane of the Ecliptic, with the sequent seasonal vicissitudes and their incessant influence upon human life.

No "great round drops" of rain descended in multitudes together, "which we call showers"; but the surface of the sphere was watered by gentle "mists"* or vapours, ascending during the daytime, and again falling in the succeeding night, when they proved the least inconvenient and nocuous to the happy race. The Earth, too, was infinitely more fruitful, and it is interesting to learn,—in these unfortunate times of pernicious vegetal organisms,—that, in Whiston's judgment, it produced "better and more useful vegetables" than are yielded at present to our troubled agriculturists.

The mountains, now bare and barren, were then luxuriantly clothed with rich verdure, and showed a fruitful capacity equal to that of the plains and valleys. And as no Ocean existed, (probably a favourite and pathetic assumption in the days of difficult and dangerous travel), a larger range of habitation, with the prevention of competitive struggle, was provided, which was seriously modified by the introduction of separating rivers and seas as a sequel to the Deluge.

Another cause, ancillary to primitive longevity, is assigned by Whiston in the fact that the Antediluvians were permitted to subsist on vegetable food alone; while it was only subsequent to the Flood that the unhappy use of flesh-foods, with their inherent temptations to luxury and excess, was allowed.

It is interesting to bear in mind,—and to find specifically exemplified,—how the validity of speculation, even when conducted

* The reader will recall the 331st and sequent lines of "Paradise Lost":

" Though God had not yet rain'd
 " Upon the Earth
 " . . . but from the Earth a dewy *mist*
 " Went up and water'd all the ground."

And in Tennyson's "Idylls of the King" (Geraint and Enid):

" But o'er her meek eyes came a happy *mist*
 " Like that which kept the heart of Eden green,
 " Before the useful trouble of the rain."

on rational and scientific grounds, forms a function, mathematically speaking, of the existing state of knowledge. In Whiston's days, any accurate physiological teachings, which now comprise a vast and substantial body of well-established truths, were utterly deficient, and hence assumption proceeded in every fanciful direction unrestrained by considerations based upon physiological organisation, functional relationships, and inter-dependent physical activities. One is reminded by these imaginative excursions of the fantastical, but seriously-propounded, notion of Paracelsus and Van Helmont that the processes of Digestion were the special care and administration of a demon, named Archæus,* whose kingdom consisted of the stomach, and who, by alchemical methods, separated and rendered assimilative the nutritive portion of the food.

Whiston's volume presents a portentous array of mathematical calculations, and the results I have described are stated by him to be deduced by indisputable mathematical processes.

Mathematical equations and relations constitute the consummate stage of exactitude,—quantitative as a grade superior to qualitative,—of the inductions of observed laws or uniformities, symbolised in Nature; but Whiston's method suggests the addition of the phrase of "Foolish Will Whiston" to that by which posterity has more popularly distinguished him. We should remember, however, that he has earned our respect by exhibiting an earnest, if eccentric, character in an age where genuine sincerity and tenacity of conscientious purpose formed but narrow and infrequent islands in a vast ocean of instability and untruth in thought and life. A fraction of real enthusiasm and simplicity of faith, even in an inferior or hopeless cause, is infinitely more valid in the creation of character,—the supreme aim and ideal of life,—than a massive and imposing accumulation of the precisest knowledge. However, we are concerned here with scientific doctrine alone.

I need only add that, in Whiston's system, the preceding conditions of Nature, internal and external, were radically altered and

* Whewell : "A History of Scientific Ideas." Vol. ii. : Book ix. : chap. ii.

deranged at the Deluge, with the involved diminution of the duration of life.

- v. The celebrated Naturalist, George Louis le Clerc, the Comte de Buffon, issued, between 1749 and 1767, a voluminous Treatise* in which this question was discussed. I have consulted the Edition of 1812, translated by William Smellie. The speculations relating to the subject of longevity are contained in Section v. of Volume iii., under the title of "L'Histoire Naturelle de l'Homme," and the sub-title of "Old Age and Death."

Admitting the credibility of the Antediluvian ages, he submits that "we may perhaps be able to give a satisfactory answer" to the difficulties of belief. In the first place, the productions of the Earth in the early history of the World were possessed of a different nature from that which now characterises them. The surface of the Globe, in primitive times, was "less solid and compact" since, in consequence of the comparatively brief period during which Gravity had then acted, terrestrial bodies had not acquired their present density and consistence. Hence, the products yielded by the Earth must have involved properties of an analogous character with the Earth's physical condition. As its surface was more loose and moist, the productions would naturally be more ductile and capable of extension in their growth, so that the human body, necessarily participating in this mode of constitution, would require a more lengthy period for completion. The softness and ductility of the bones and muscles would probably continue for a longer time, since every description of food was softer and more succulent. Hence, the full expansion of the body, or the advent of the epoch of capacity for generating, must have demanded from 120 to 130 years, and the general duration of life would be proportionate to the term of growth,† just as a similar relation is ascertained to be uniform at present. If we supposed the stage of puberty, in the primitive race of man, to have comprised 130 years (the existing period being 14, adds Buffon), the total age of the

* "Histoire Naturelle des Animaux, Générale et Particulière," in 15 volumes.

† *Vide* the references on this important physiological proposition furnished on page 132.

Antediluvian would be in exact proportion to that of the existing race; since, multiplying these two numbers by 7,* we find that, as the extreme age of mankind at present is generally 90, that of the Antediluvian must have been 960.

Buffon here refers to a physical uniformity or law of significant value, which I purpose discussing more fully in Chapter VI.

Buffon conjectures that the term of man's existence may have gradually diminished in proportion as the surface of the Earth acquired a greater solidity in consequence of the constant and prolonged operation of Gravity; and that, not improbably, the space of time intervening between the Creation and the age of David afforded a sufficient area for providing the Earth with all the density it was capable of receiving from the influence of Gravitation. The Earth's surface, consequently, has since remained in the same condition, and, concurrently, the term of growth, both in the productions of the soil and the duration of human life, has been invariably fixed from that epoch.

Buffon, it may be added, accepts the "extraordinary instances" of longevity in Jenkins and Parr, and states that many other examples have been furnished of the prolongation of life to the age of 110 and even 120.

- vi. In 1680, appeared an elaborate Dissertation, in two volumes, by Thomas Burnet, D.D.,† late Master of the Charterhouse. I have perused the 7th edition, which bears, in the Dedicatory Epistle, the date of 1683.

Burnet vindicates minutely the universal character of the Deluge, —extending, as he remarks, from "pole to pole, and from east to west,"—and assigns its occurrence at about 1,600 and odd years after the Creation.

After premising that the longevity of the Antediluvians was providentially designed for the purpose of the rapid propagation of

* *Vide* the hypothesis of Flourens on page 134.

† The Sacred Theory of the Earth.

mankind, he points out that, during the interval of 1,600 years, the multiplication of men would be enormous; for, starting with a single couple, and assuming a quintuple, or even only a quadruple, ratio of increment, the number of descendants in the first century would be 10 (*i.e.*, he estimates that the primary couple, at the end of 100 years, would leave 10 pairs of what he terms "breeders"), while, in the 16th century, the population would amount to 10,737,418,240.

In explanation of the Patriarchal longevity, he states that the "vitals" of his Theory, in his own quaint expression, consisted in the fact that, prior to the Deluge, the Earth enjoyed a perpetual Equinox, or Spring, by virtue of its "right" situation in relation to the Sun,—which was then direct and not inclined or oblique, with its axis parallel to that of the Ecliptic,—and presented a regular oval figure, with the consequent and subordinate condition of constancy of Nature, untroubled by seasonal change; its exterior surface, moreover, was perfectly smooth and uniform, devoid of mountains and seas: the air, too, was perennially serene. The protracted lifetime of its inhabitants may be deduced, with certainty, from these physical phenomena. The soil, again, in this pristine freshness of Nature, was eminently fertile, composed, as it was, of the "richest and fullest" mixture of a light earth mingled with "unctious" juices, and refreshed by the dews of heaven throughout the year; combined with an equable and continuous quality of Solar warmth. The productions of the Earth accordingly were more finished, fuller, and purer; its fruits were lavishly spontaneous, and no necessity then existed for the land being "torn and tormented," "pressed and squeezed," in order that man might win a bitter and precarious livelihood. The Antediluvians thus pursued a simpler and more regular mode of life, as their diet, according to some conjectures, was restricted to vegetable food: no fatal expansion, therefore, of luxurious habits had engendered gluttony and its attendant vices. It has also been supposed that the Earth's productions, its herbs and flowers, possessed some special inherent virtue which the Deluge caused to disappear; but Burnet points out in criticism, that where, in existing conditions, extreme longevity is attained, the excess vitality is chiefly attributable to purity of the air and the temperature of the heavens.

The stamina* of the Antediluvian were no doubt more vigorous, or the first principles of man's constitution; for the principal organs, namely, the stomach and heart, as the mainsprings of the corporeal mechanism, are more or less durable and constant in accordance with the character of the phenomena of external Nature. This primeval energy and persistence were affected by the altered physical conditions, which the Deluge introduced, through the noxious composition of the air, and the inequality of the seasons.

The atmosphere, he insists, was absolutely and unchangeably unfretted by storms, rains, snow, meteors, clouds, and winds; the surface of the globe was watered by dews alone; no mountains, rocks, or caves, or seas,† or oceans ruptured or diversified its uniformly smooth and symmetric form; no summer or winter, seed-time or harvest, were needed during the equable temperature of the air and the perennial verdure of the land: exterior nature thus perpetually exhibited a changeless and propitious aspect, and men's bodies then existed in one continuously pellucid medium, while the Deluge has entailed upon them the bitter experience of being now "steeped in water," and then "in misty foggy air."

He alludes to the absence of the anxieties, competition, and hurry of life, due to an extended system of Industrial Enterprise; and, enlarging upon the undemoralising character of former days, he contrasts the absolute simplicity of pristine manners, the sufficiency of tents and vernal bowers for homes; the happy uselessness of mercantile traffic when Nature spontaneously lavished her gifts indiscriminately upon all; while the denizens of the primitive globe, possessing no subterraneous metals or minerals, lived undistracted and untainted by the fevered struggles which the quest of gold and silver produces.

* I venture a note. The word "stamina" is frequently employed erroneously as a singular noun. It is the plural of "stamen," a filament, and refers to the threads, fragile or durable, with which the Parœ wove the texture of individual life.

† This feature, and the corresponding fancy of Whiston, would seem to be an echo of the pathetic and impressive Vision of John in the Apocalypse (chap. xvi., v. 2),—the earliest of his writings,—that in the regenerated globe "the sea is no more,"—the symbol in that untravelled time of partings that might never be re-knitted, and of perils whose unknown nature dimly magnified their awe.

And, finally, he paints an alluring picture of that golden age, with its perennial composure of eternal calm ; its unchanging serenity ; its fields displaying, under the benign sway of perpetual spring, a changeless green ; its bloom of flowers fragrantly fresh and pure ; and its trees luxuriant and redolent, without decay or fall, with leaf and fruit. I need not add the moral, which Burnet depicts in sombre detail, as an umbral appendage to every pictured excellence of this period, by punctually repeating that each darkened reverse of this series of descriptions ensued upon the Deluge.

vii. It will be noticed that an essential feature of pristine antiquity was supposed to consist in the absence of meteors and storms. In early ages, it was universally accepted as a cardinal article of faith that Comets and Meteors were missiles or fireballs hurled by an indignant Deity at a wicked world,—a conviction which, adopted in the primitive Church, was transmitted through the mediæval ages, to the period of the Reformation,—and continually supported by texts, literally interpreted, from Scripture ; while lightning formed the destructive weapon of a beneficent God in his wrath, or even embodied the agency of evil spirits ;* and thunderbolts were demonstrated to be of diabolic origin on account of the eccentricity of their operation and the smell of sulphur which accompanied them ; while tempests again were the production of the Prince of the Power of the Air and his attendant demons.†

viii. The celebrated Physiologist, Albert Haller, devotes a section to the subject in the 8th volume of his *Treatise*‡ under the title of “*Longœvitas Antidiluviana*.”

He considers that human life was much more extended anterior to the Flood, and with longer stages (*stadia*), while, since that

* Tertullian, indeed, was convinced that lightning was identical with hell fire.

† A. D. White, “*A History of the Warfare between Science and Theology*,” Vol. ii. : chaps. xvii. and xx.

Lecky, “*History of Rationalism in Europe*,” Vol. i. : chap. i.

‡ *Elementa Physiologiæ* : Vol. viii. : Lib. xxx.

memorable epoch, "*cujus vestigia per totum orbem terrarum sparsa sunt*," man's existence tended to diminish. He refers to the limitation to vegetable diet before the Deluge, and the subsequent and deleterious use of animal food; the inferior density of the physical frame; the surface of the globe being vastly different, and conducive to prolonged life; he asserts that rains never troubled the race; that less earthy matter was contained in pristine foods, where we now admit into our bodies, through the consumption of flesh, 11 times more earth than our antediluvian ancestors absorbed; while, certainly, the clearest observations attest that mountains, which, at the Flood, buried mounds of shells, were themselves extremely soft, since they admitted and revealed the impressed figures of these submerged bodies: "*Mutata forte sunt in Diluvio omnia, aer, aqua, anni tempora, meteora, terra*." But "*sit ergo problema*," he concludes, "*ob paucitatem datorum insolubile*"; though there is nothing repugnant to reason against the existence, in that period, of extreme instances of longevity ("*Nihil autem repugnat quin longeviores, quam nostro ævo, homines olim fuisse potuerint*").*

- ix. Mr. Joel Pinney,† apparently borrowing from previous writers, attributes the longevity of the Patriarchs to the absence of disease, and a deeper intensity and vigour, of the "first principles" of the physical constitution; the prevalence of a more "natural" temperature than that which has been experienced since the Flood; with continuous uniformity of seasons and evenness of the weather; the spontaneous production by the Earth of suitable and sufficient food, in purity of composition, without anxiety or excessive toil by men; the abstinence from animal diet, and the consequent avoidance of intemperance, gluttony, and excitement.

It is curious to observe, in all these speculations, the prevalence of what the jurist, Jeremy Bentham, termed "question-begging epithets," or the assumption, in the terms employed, of the very proposition it is intended to prove,—a very customary form of

* *Longœvitas Antediluviana.*

† *The Duration of Human Life.*

argument where clearly-collected and discriminated facts and scientific processes are either ignored or unapprehended. It will be noted that Pinney introduces the word "nature," and, in another place, the conjecture that the plants and fruits were, in those days, "probably nearer to nature" than formed the experience after the Deluge. These writers, like so many speculators in Morals,—(for example, the ethical formula of the Stoics of conforming life to the standard of Nature),—adopt a personal, arbitrary definition of "Nature" (and always in the loosest and most indefinite form), as a criterion of comparison, and propositions are correct or fallacious which appear to resemble, or diverge from, the test thus vaguely established. No more extensive and popular mode of Error exists; and particularly where the expressed Notion, such as "Nature" is, possesses so complex a compass as to become, in the phrase of Leibniz, purely symbolic. Judgments based upon such views are as nebulous and inconclusive as the minds by which they are obscurely and helplessly conceived. Results can only be true when they conform to a standard, adopted by all, or the majority of, investigators who are most competent by character, scientific discipline, and matured study, to constitute a Tribunal of Judgment.

- x. Sir Henry Holland stated* that, in omitting all reference to the length of Antediluvian life, he proceeded on the ground that the solution of the problem depended upon conditions and upon a state of the world to which no modern knowledge could apply. A conclusion of this character, if generally adopted, would raise a barrier against all investigation; but, in addition, the statement is curiously inept since the advent of Lyell's reasoned and sagacious doctrine,† which all Geologists accept, of the continuity of the existing causes of terrestrial changes and modifications as far back as scientific enquiry can extend. This Principle of physical Uniformity is in precise consistency with the universal exhibition of Evolution which Mr. Herbert Spencer has so luminously and impressively presented throughout Organic

* The *Edinburgh Review* for January, 1857 : in an Article on Human Longevity.

† The Principles of Geology.

and Inorganic Nature and in the Cosmos at large,—indicating that the Causes at present operating—the rains, the frost, the tides, volcanoes, and earthquakes,—were competent, in gradual sequence and over lengthened periods of time, to produce every past alteration of structure and composition which the ancient history of the Earth discloses to the disciplined eye and mind.

- xi. And with a closer restriction to our particular subject, the distinguished Comparative Anatomist, Sir Richard Owen,* has pronounced, as the result of unrivalled knowledge in his department of Scientific enquiry, that Palæontology consistently teaches that both plants and animals have advanced in grade, power, and conditions of life-enjoyment after each geological epoch; so that the true scientific inference is that the Earth, water, and atmosphere are more favourable to longevity at the present time than at any anterior era in the record of the mutations of the globe. The Laws of Correlation, so far as observation has proceeded, and this now stretches back to thousands of years prior to the date in the Hebrew Scripture of the creation of man,—have continuously prevailed, and governed all animal structures. He points out that the rule of length of human life, if the individual pass through his various phases to the concluding stage of senility, is furnished, with approximate accuracy, by the Psalmist as 70 years, and that, although, with a progressive advance in material appliances for conservation of the physical forces, the age of 80 may be reached, the limit of human life has not been extended beyond 105 years, while all existing observations on the clearest authentic data suggest 103 years and a few months as its present ascertained boundary. Professor Owen concludes by affirming that no Physiologist at the present day, of whatever degree of distinction in science, admits the possibility of an animal possessing the characteristics of the

* *Fraser's Magazine* for February, 1872: an Article on Longevity.

genus homo attaining to any of the ages recorded of the Patriarchs.

- xii. Before referring to two modern writers, I ought not to omit all mention of the celebrated Treatise* by Augustine, Bishop of Hippo, the greatest of the Latin Fathers, where we naturally find dogmatic allusions to the subject. So sinister, in my judgment, has proved the influence of Augustine upon the progress of Science, and the consequent happiness of man; so disastrous has been his insistence on the material interpretation of the words, "*Compelle intrare*,"† as mainly the origin and apology of the Spanish Inquisition and of the various abhorrent forms of mediæval compulsion by torture; so fatal has been the barrier which his doctrine of Predestination erected against enlightened and spiritual conceptions of the gracious government of God, that, though I admire the sanctity of the Christian period of his life, I cannot avoid some feeling of repugnance in the study of his works. In support of the Scripture upon the question of Patriarchal longevity, and, especially, the abnormal size of men's bodies in those primitive times, he naïvely employs, as an argument, the assertion of Virgil (*Æneid* xii., 899, 900) that, in the ancient period, a huge mass of rock, which had been fixed as a landmark, and which not even twelve strong men of his degenerate days could move, was snatched up by a warrior as he fought and hurled with envious ease. And, adopting an *a fortiori* mode of reasoning, he observes that if, in the age described by Virgil, this physical strength existed, how immeasurably greater must have been the muscular power prior to the Deluge.
- xiii. In the course of a Contribution‡ to the Transactions of the Royal Society in 1825, by the distinguished Mathematician and Actuary, Mr. Benjamin Gompertz, an interesting allusion

* De Civitate Dei: Books xi. and xv.; produced in 413-426 A.D.

† Luke xiv., v. 23.

‡ On the Nature of the Function expressive of the Law of Human Mortality.

is made to the subject. He observed (Art. 3) that, if the law of mortality could be so precisely expressed that, after a certain age, the numbers living (that is to say, the successive survivors out of a given aggregate of observed persons with which the table of mortality started), corresponding to ages increasing in an arithmetical progression, decreased in a geometrical progression, the life-annuities for all ages beyond that period would possess an equal value; in other words, if the annuities were to continue for the whole term of life, their present capitalised worth would be independent of the age. This presents the theoretical aspect of the case, for it may be parenthetically noted that, in the practical mode of calculating tables for business purposes from a *limited* number of persons at the commencement of the series, and with the retention only of integral numbers, a limit is necessarily assigned to the tabular or indicative possibility of life. The assumption of a geometrically progressive law of mortality of this theoretic nature would make it appear that no positive limit existed to a person's age; and yet it would be easy, even in the case of this hypothesis, to prove that a very limited age might be assumed to which it would be extremely improbable that any human being should have been known to attain. For postulating that, from age 92, the rate of mortality should disclose that one quarter of the persons existing at the commencement of each year were to die during the course of that year—(a supposition which approximately represents the mortality expressed by the Carlisle Table between the ages of 92 and 99),—the chances would be upwards of 1,000,000 to 1 that out of 3,000,000 persons, whom history might record to have reached 92, not one would have attained the age of 192, in spite of the fact that the present value of life-annuities at all ages over 92 exhibited an equal value. And although the limit to the possible duration of existence is never likely to be determined, even should it prove to be a fact, it is interesting to consider a consequence which would ensue should the mortality of old age follow the course just hypothetically

assumed. For it would result that the non-appearance in the pages of history of a single instance of a person having reached a certain ultimate age would not afford the slightest evidence of the existence of a limit to the age of man, and, further, that "neither profane history nor modern experience " could contradict the possibility of the great ages of the " Patriarchs of the Scripture."

It is simply necessary to observe, as a criticism on these assumptions, that no data exist for determining the *possibility* of the duration of human lifetime, either on direct physiological observations or in Tables expressive, by a comparison between the numbers living and dying at each successive age, of the rate of mortality which involves such data, and that the only method competent of serviceable adoption is that of Statistical or Historical Evidence confirmed by adequate verification.

- xiv. A recent Essay* by Professor Karl Pearson contains an interesting reference to the question.

In treating of Statistics generally, he defines the "mode" as that observed occurrence of events which happens, not necessarily a majority of times but, more frequently than any other occurrence; and observes, that actual statistical experience, not simply Theory, impresses us with the conviction that, whatever be our ignorance of what will occur in the individual instance, yet the Frequency of a considerable number of events is distributed around the "mode" in a manner more and more smooth and uniform proportionately to the mass of individual cases. He accordingly proceeds to form a conception of a Generalised Frequency Curve by grouping the observed facts into different sets, defined by the extent of deviation of each from the "mode,"—each collection comprising the deflections which fall within a certain small range,—the same for each particular set. He then represents the "mode" by a point on a horizontal line; measures the deviations from the "mode" along that line; placing the excess deviations to the right of the point, and the deviations in defect to the left. Drawing from the centre of each range, a vertical

* The Chances of Death, and Other Studies in Evolution. Vol. i.

line, whose length is proportional to the number or Frequency of observations exhibiting a deviation falling within that range; and joining the summits of these verticals, he obtains a polygonal figure which more and more closely approximates to a Curve, the smaller the range of deflection which is adopted corresponding to each group. The resulting Curve, Professor Pearson describes as the "Frequency Curve," which indicates, by its height at any point, the Frequency of occurrence of the relative scale of deviation from the "mode."

The curve gradually ascends rather steeply to the right; makes a gradual and less steep flexure convex to the horizontal line; then slopes more slowly, and continues its course as a kind of asymptote to the line. Its general features disclose the fact (i), that the "mode" is not necessarily identical with the "mean," so that the differences between the "mean" and "mode" afford a conception of the amount of asymmetry, or "skewness," of the curve; and (ii), experience shows that very large deviations possess very little, or even no, frequency,—the preponderant mass of the Frequency being contained within a comparatively limited area round the "mode" and "mean." And Professor Pearson adds that, "from paupers to cricket-scores, from "school-board classes to ox-eyed daisies, from crustacea to birth-rates, "we find almost universally the same Laws of Frequency." Now, taking the Registrar-General's Returns of population and deaths among males; starting with 1,000 who commence life together; and noting the deaths that occur in each year; Professor Pearson obtains a Curve of Mortality presenting the successive ratios between the living and the deaths: regarded as a whole, the Curve is different in form from any of the Frequency Curves he had constructed from other classes of data; but a greater likeness is visible to the half of the Frequency distribution of facts, as exhibited by the typical curve, when the old-age section of the Mortality Curve is alone contemplated. The curve in its sweep to the right is terminated at 106·5 years,—a point which would indicate a theoretical limit to human life. Too great importance, however, he remarks, cannot be attached to this limit, for he found that an almost insensible change in the form of the curve increased the theoretic end of life by about ten years. The significance of the case consists in the fact that a curve of this type

does furnish somewhere a theoretical boundary to life; and we may regard the age of Methuselah (969 years) as "extremely improbable, but not impossible."

This is an interesting and ingenious study, but, as I have stated, we are, at all events in present circumstances, restricted to the Historical method of enquiry and verification.

- xv. Reverting, for a moment, to the prevalent conception, on the assumption of a general retributive Deluge, that this catastrophe formed a consequence of human sin—a notion derived by all writers from the Hebrew tradition,—I may mention that Robert Southey* records a curious conjecture, as a reason for the necessity of the Flood, contained in How's "Devout Meditations," that if, in our brief life, man can perpetrate so enormous an amount of mischief, what massive and unimaginable evil might not have been compassed had he still been permitted to endure for 900 years! One Tiberius, or Caligula, or Nero, or Louis the XIV., could have obliterated the race. Hence the Deluge was designed, not merely to destroy existing offenders but also, to prevent future human capacity, in respect of time, from accomplishing an accumulated enormity of wrong.

Leaving these baseless fancies of Whiston and Burnet,—supported as they are by an imposing accumulation of mathematical symbols as though to impress upon them the seal of analytical exactness of expression, and the aggregated and obsolete physical properties, linked together and modified by the touch of an imagination, whose adjustive services were ever in requisition, to harmonise discrepant relations,—I proceed to the more prosaic task of adducing reasonable grounds on which the accuracy of these portentous ages may be rationally impeached.

* The Doctor : chap. cxxxii.

IV.—THE EXALTATION OF THE PAST.

Mr. H. T. Buckle* has pointed out the persistent tendency in every age to magnify the records and conditions of prior periods at the expense of present times, and has instructively illustrated the manner in which this erratic intrusion of the imagination has proved fertile of mischief in every department of thought, and in the progress of scientific research, through the depressing weight of indefensible authority attached to ancient conceptions and conclusions, with the consequent stagnation, from the absence of unfettered and critical judgment, of intellectual advance. The student will recall, as a familiar example, the fine chapters† of Whewell, in which he depicts the paralysing era of the Schoolmen and Commentators; and the famous intellectual conflict between the great Bentley‡ and the Honourable Robert Boyle affords a corresponding illustration in a different sphere of enquiry.

The attribution of excessive longevity to the early ancestors of the Race is evidence of this spirit, for, obviously, the Hebrew people possessed a mental and emotional constitution in no way divergent from that of other Nations, though it is to be admitted fully that, just as the Greeks exhibited, in an exalted mode, the conception of Beauty and formed the chief natural depositaries of Æsthetics, and the Romans inherently excelled in the special department of Organisation and Law, so the Hebrews appear to have been particularly signalised, in the spiritual rank of Nations, by a pre-eminently perceptive Power of the quality of Awe and of Religious Thought.

Now, in the ancient Literature of India,§ the primitive duration of life shows a similar character of the marvellous, where men were asserted to have commonly lived for 80,000 years; holy men attained

* A History of Civilisation in England : Vol. i., chap. ii.

† A History of the Inductive Sciences : Vol. i., Book iv. : chaps. i. to v. ; and also in "The Philosophy of Discovery : " chap. ix.

‡ The Life of Richard Bentley, D.D., by J. H. Monk, Lord Bishop of Gloucester : Vol. i. : chap. iv.

§ Asiatic Researches.

100,000 ; but, in the most flourishing period of Indian antiquity, the term of 100,000 years constituted an average length of existence.

From the records of Babylon,—a race analogous to that of the Hebrews,—we discover correspondingly exaggerated statements. The history of Babylon was translated from its own clay tablets into the Greek language by a Chaldean priest, Berosus, who lived in the third century before the Christian era. His work is entirely lost except a few fragments ; but from these, and especially from the recently-discovered Tablets* in cuneiform character we learn that, prior to the Deluge—(of which, as I have mentioned, a marvellously parallel record to the Hebrew tradition has been exhumed on clay in the Epic of Izdhubar (identified with the Nimrod of Scripture), Canto xi,—a redaction of independent Chaldean poems of an earlier date,—the Epic itself having been existent about 2,000 years B.C.),—ten kings reigned for an aggregate period of 432,000 years, or 43,200 years to each reign ; while, after the Deluge, the first dynasty of 86 kings governed, in all, for 33,091 to 34,080 years, or about 780 years each ; and their immediate five successors attained only the degenerate age of from 35 to 48 years apiece.

V.—THE APPLICATION OF HISTORICAL CANONS OF EVIDENCE TO PRIMITIVE RECORDS, AND ITS RESULTS: THE MYTHOPŒIC TENDENCY.

Again, the “Revolution,” as Dr. Liddell† terms it, effected in 1811–1832, by Berthold Georg Niebuhr‡ in the interpretation of early Roman History (in which he was followed by our distinguished countryman, Sir George Cornewall Lewis, who published a well-known work§ in 1855) has cast an illuminative and startling reflection upon that innate tendency in man to exaggerate and distort the chronology of primitive times.

* Geo. Smith : *A History of Babylonia* : chap. i.

† *A History of Rome*, Vol. i.

‡ *Römische Geschichte*: (translated in 2 volumes, by J. C. Hare and Connop Thirlwall).

§ *An Enquiry into the Credibility of Early Roman History*.

The entire history of Rome was formerly regarded as entitled to implicit belief, and all ancient authors were treated as equally credible without the application of any critical discussion. Both these writers accordingly applied to the original records of Rome, the same rules of evidence which, by common consent, are employed in the decipherment and analysis of Modern History; and, in pursuance of this historical and critical method, they have proved, beyond doubt, that the assumed origin of Rome possesses no historic truth; that the reigns of Romulus and Numa are purely fabulous and poetical; that the list of the Alban Kings is a late and clumsy fabrication,—a mere medley of appellatives, of which some have been carved out of geographical names;* that the period from Tullus Hostilius to the first secession of the Plebs is mytho-historical, *i.e.*, composed of truth and fiction; that no dependence can be placed on the history of Rome prior to the age when contemporaneous writers can be referred to; that the Roman Narrative from the foundation of the City to the expulsion of the Tarquins is constructed out of traditionary and legendary materials; and that the conclusion is irresistible that no credibility can be attached to the records down to the landing of Pyrrhus in Italy in 281 B.C.† In a manner paralleled in the primitive narratives of all Nations in their ante-historical development, lays and legends and stirring tales were preserved and transmitted orally in the memories of men; compounded of Religious Myths, which embodied an explanation of the phenomena of the Universe, and Heroic or Historical legends relating the early story of the people;‡ and a mere remembrance of human frailties and of the spontaneous and specific tendencies of universal human feeling and conception will suggest the possibility, and indeed the necessity, of omissions, accretions, and modifications, from stage to stage, of the unwritten transmission. And when the narrative is finally settled in writing, the confusions and errors of the copyists of Manuscripts add change to change.

A similar application to ancient times of the laws of adequate

* Niebuhr : op. cit. : Vol. i.

† Lewis : op. cit. : Vol. i. : page 265.

‡ Liddell : A History of Rome : Vol. i.

evidence, which now form the mode of interpretation of Modern History, was accomplished for Grecian story in the "Epochmachendes" Work of Mr. George Grote,* published in 1846-1856 in 12 volumes.

He shows, Chapter xv., the purely legendary character of the siege of Troy ; that no evidence exists beyond the wonderful Homeric Epic itself ; that this Epic (Chapter xvi.), it is true, consists of traditions, but that the traditions are merely the substance of ancient songs and stories, the creations of the poets and narrators themselves, each of whom discovered some lays pre-existing, and added fresh ones of his own "under the impulse and authority of the inspiring Muse" ; and that (Chapter xix.), although many writers have attached historic credibility to Grecian events, which occurred between 1184 and 1104 B.C., his own investigation compels him to the conclusion that the mass of incident anterior to the first recorded Olympiad, 776 B.C., appears to be irreducible either to history or to chronology ; and that any chronological systems which may be applied to that earlier period must be essentially uncertified and illusory. As pertinent to the discussion, the valuable observations of Mr. Grote upon the mythopœic tendency, universal in the mind, and the genesis of Natural Myths, are most instructive. The word "myth," he observes (Chapter xvi.)—(*μῦθος*=fabula=story)—signified originally a statement or current narrative without any connotative implication of truth or falsehood. The meaning subsequently changed as the result of a silent alteration in the mental state of society—of a transition to a more elevated canon of credibility, in consequence of familiarity with recorded history, and its affirmative and negative tests, to which the original hearers of myths were strangers. Myths, or current stories, constituted, in the Grecian world, the entire intellectual stock of the age, and can only be understood or appreciated, (and this appears to me to be a proposition of universal application), with reference to the scheme of conceptions and beliefs of the period in which they originated. And here we must suppose a people who did not read or write, but merely saw, and heard, and told ; destitute of records, incognisant of tests of evidence ; devoid of any physical philosophy, and of any rational conception of the uniformities and sequences in Nature, and yet eager

* A History of Greece : Vol. i.

for some connecting hypothesis to interpret the phenomena displayed. Myths, then, are a special product of the combined imagination and feelings; and were originally evolved in an age which, in addition to the defects just noticed, was full of a religious faith. And this mental condition, this myth-constructing faculty, is inherent in the unlettered, imaginative, and believing human mind; presenting itself, and its interpretative results, in every stage of social progress, and in almost every region of the globe.

The legendary character of our own English History has been clearly revealed. Mr. Grote himself has incidentally shown (Chapter xvii.) that our old historians, from the twelfth to the seventeenth century, accepted the tradition as certain that our national story commenced with Brute, the Trojan, and was thence carried down, through a long succession of Kings, to the times of Julius Cæsar; while, as he states, notwithstanding this concurrent conviction of many centuries, with their historians and poets, including Milton, the writers of the nineteenth century begin the History of England with Julius Cæsar. And although I make the reference for completeness, I need not detail the investigation which Dr. E. A. Freeman records in his essay on "The Mythical and Romantic Elements in Early English History,"* and in which he confirms Mr. Grote's conclusion, and adduces other examples of the accretion of myths.

This lengthy, but necessary, preface to the present section of the enquiry may be summed up in the propositions (i) that in primitive and unlearned times—not at all, however, unintelligent days, for the spirit, ingenuity, and poetry of multitudes of myths testify to a keen mental curiosity, a vivid imagination, and, frequently, a refined æsthetic power of perception and analogy—the mythopœic tendency of the mind is a necessary and natural phase of intellectual development; (ii) that its products are not devised and intended delusions, but genuinely attempted solutions and decipherments of the diverse phenomena of the Universe, which the mind is innately compelled to explain and connect,—in early stages, largely by the mode of Personification; in more advanced ages, by the nexus of scientific

* *Historical Essays: 1st Series: 4th Edition.*

Positive laws; and (iii) that a patient investigation of these symbolisms, and their comparative unity of spirit and aim, is imperative if the student earnestly seek to trace the intellectual and moral progress of the Race.

The Hebrew people, in its primitive history, naturally possessed the mental equipment common to universal man. They originated myths of explanation, and, in congruence with the profound depth of their characteristic capacity of Religious faith (which is one of the elements, as we have seen, which Mr. Grote enumerates), their legendary traditions were conceived under the influence of this spirit and of invariably ethical relations and connexions. The equally oral nature of their early traditions included the inherent possibilities and certainties of confusion, accretion, and modification; and the corruptions and anomalies, incidental to the transmission of knowledge, especially during the lengthened period when the lays and legends, which constitute the basis of all ancient history, depend solely for their preservation upon the precarious,—though, in those eras, the marvellously cultivated,—memories of men. An application of the established principles of historical criticism to these narratives will excise the floating of the iron axehead on the water*; the cessation of motion of the Sun and Moon on Gibeon and Aijalon†; the reversion of the dial's shadow, of Ahaz‡; and the records of Patriarchal lifetimes, inconsistent, as the latter are, as a prolonged series of individual instances, with the researches of Geology, the testimony of attested History, and the persistent uniformity of the human structure to which Physiology and Physical Science bear unimpeachable witness. But although these excrescences disappear,—under the explanation of the myth-forming faculty; the invariable impulse to objectify personal feelings and mental modes of thought; and the inevitable tendency to magnify the heroic leaders of a departed age,—the noble simplicity and exalted type of the National record remain. Indeed, the more steadily the canons of evidence are applied, the more profoundly is the mind impressed with

* II Kings: vi.: vv. 5 & 7.

† Josh. x.: vv. 12 & 13.

‡ II Kings: xx.: vii.

the Unifying completeness of conception which the Hebrew Scriptures display: the purity and consistent exhibition of the Monotheistic Idea; and the reference, even in these legends, of all the forces of human and material activity, of all the varying sequences and events of life, to a standard of judgment which is supremely Moral. We perceive, in the strictures on Sin, no mere "missing of the mark," as in the Grecian mode of interpretation; no arbitrary or *unmoral* connexion between an act and its consequences, but the changeless and lucid presentment, not simply even of a moral nexus but also, of a profoundly conceived relationship to the Divine Will, throughout the entire region and phases of human conduct and physical phenomena. And, as I shall hereafter attempt to show, the attribution of extreme longevity to their famous ancestry was essentially a practical expression of this uniform moral notion under the influence of the prevalent Hebrew conviction,—rehearsed in many touching passages of their poets, and imbedded in National thought,—that Divine approval of human action was largely and eminently conveyed and uttered in length of days.*

VI.—SACRED AND FATEFUL NUMBERS AND WORDS; AND THEIR INFLUENCE UPON PRIMITIVE RECORDS.

Among the peculiarities, attendant on the development of mankind, is the mystic meaning attaching to certain numbers, words, and phrases. Numbers were originally regarded as intrinsically significant.

And especially were the numbers 3, 7, and 10 assumed to possess very important attributes. The number 3 is extremely favoured†; it exhibits for the first time, says Bähr, on the scale of figures, a beginning, a middle, and an end, when dissected, and, being non-divisible, it is the first number also which expresses perfect composite unity; it constitutes the symbol of Godhead. The number 7

* Two of the reasons assigned by Josephus (*Antiquities of the Jews*), for the Antediluvian duration of existence are that "those Ancients were beloved of God," and that "their food was then fitted for the prolongation of life."

† Kitto: *Biblical Cyclopædia*. Smith: *Dictionary of the Bible*.

denotes a full and complete idea, compounded, as it is, of the factors 3 and 4, indicating thus the conjunction of the symbols of the Deity and of the external World as his Kingdom, so that it signified the union of God and his creation; for the number 4 represented the "signature" of the world, with its four cardinal points. In connexion with the numeral 4, the ineffable Tetragrammaton here recurs to memory. The number 2 symbolised competency or sufficiency; 10 was not infrequently introduced into this mystic cabalistic scheme of symbolic representation of objective or subjective facts; and, for the reason that 6 was a perfect number, the opponents of the Copernican system of Astronomy contended that only 6 planets could exist. The number 5 appears in the Jewish Table of Punishments and the Legal Requirements; while, as regards the number 6, once more, Augustine* remarks that it possesses a perfect character and exhibits the completeness of God's work as displayed in the period of Creation. For it is the first number which is composed of its own aliquot parts, *i.e.*, of its $\frac{1}{2}$ th, $\frac{1}{3}$ rd and $\frac{1}{6}$ th, which are respectively 1, 2, and 3.

The Pythagorean School, learned in the mathematics of their Master, furnish a similar illustration of the integral virtues residing in numeration. † Number appeared to them to be the foundation of all shape and qualities; it constituted the $\delta\rho\chi\eta$ and $\sigma\lambda\gamma$ of which the Universe was constructed. Identifying objects merely on the ground that they could be described by the same verbal terms, the School propounded the notion that as a cube possessed three equal measures, and eight has three equal measures or factors, the number eight,—the first cube,—symbolically represented Justice, whose capital function it is to allot equal measures to all men. Attaching the attribute of perfection and finality to the number ten, the School, acquainted only with nine celestial bodies, asserted that there must exist an Antichthon, or counter-Earth, in order to constitute this number in space, situated on the further side of the Sun, and, therefore invisible. ‡

* De Civitate Dei : Lib. xi.

† J. Gow : A Companion to the Classics : chap. xxxiii.

‡ J. S. Mill : A System of Logic : Vol. ii. : Book v. : chap. v.

Dr. H. G. Liddell* has pointed out that in mythical Roman history, owing to a similar valuation of numbers, Æneas is stated to have reigned three years; his son and successor, Ascanius, $3 \times 10 = 30$ years; and the descendant race of the Sylvii, $3 \times 10 \times 10 = 300$ years—an ascending series of 3 and 10.

The number 3 again guided Romulus in the framing of the political institutions he erected; and he divided the people into 3 tribes or nations; while the term “tribus” itself originally signified a third part.

Mr. Grote† mentions the suggestion of the eminent C. Müller that the ancient Greek chronologists were directed in their arrangement of mythical events by certain numerical artifices, and especially by a reverence for the cycle of 63 years, produced by the sacred numbers 7 and 9. Mr. Grote, though not acquiescing in this particular explanation, considers it to be probable that some preconceived numerical hypothesis *did* regulate these early calculations.

And it may be noted, as a stage of numerical conception, that, while the number 3 prevailed in the annals of the early history of Rome, there suddenly occurred, in the period of Tarquinius Priscus, a deviation in favour of the ruling notion of the figure 2.‡

In language§ we trace this tendency in the doctrine of the Analogists, who maintained that names existed by Nature (*φύσις*), and implied a necessary and mystic connexion with the things they signified; as opposed to the teaching of the Anomalists, who regarded words as originating by Convention (*θέσις*), and forming merely the arbitrary signs of conceptions. The early Jews appear to have accepted the views of the Analogists in their extremest form, and allusive applications of names are contained, *e.g.*, in Isaac, Esau, Shem, Eve, Abel, and Solomon. We perceive the prevailing notion also in the “*Συ λέγεις*” of Jesus Christ before Pilate.|| This supposition of

* A History of Rome: Vol. i.

† A History of Greece: Vol. i.: chap. xix.

‡ H. G. Liddell: A History of Rome: Vol. i.

§ F. W. Farrar: Language and Languages: chap. xxii.

|| Matt. xxvii., 2; and the parallel passages in the other Gospels.

De Quincey: Modern Superstitions.

the intrinsic significance of words sprang from the belief that language was divinely inspired, and must therefore express the thoughts and intentions of the Divine Original. We discover the same mysterious and rigidly necessary relation between names and their meaning in the *εὖ φήμι** of the Greeks, the *favete linguis* and *bona verba quæso*, of the Romans ; the phrase of *vixit* in place of *mortuus est*† ; and the change of the names of towns, as, *e.g.*, the substitution of *Dyrrhachium* for *Epidamnium*. Indeed, the universal prevalence of Euphemism, as a principle of language, is dependent on the popular credence in the fateful power of words to realise the fulfilment of what they denote.

Admitting for a moment that the transmitted ages of the Patriarchs are correctly furnished in the copies of the Hebrew Scriptures, which assumed their present form at the dawn of the Historical period—(and omitting here the consideration of the question of errors of transcription from more ancient and legendary times)—I proceed to submit a few observations. It is difficult to perceive in the composition of the present Patriarchal figures, any definite artificial or mnemonic device, such as frequently attaches to the enumerations of antiquity ; but it will be observed how the numbers are generally found to be multiples of 3, 5, 7, and ten,—the sacred numbers,—while the ages recorded after the Deluge do not, except in two instances, form multiples of 3, 5, or 7. The number 5, it should be noted, is the difference between the omnimystic 7 and the wonderful symbolism of number 12.

Mr. E. J. Fripp,‡ however, has pointed out the artificial character of the Hebrew chronology in the fifth chapter of Genesis, corresponding to the parallel tendency in all primeval records. Noach is, he observes, older than his ancestors before he had a son, apparently in order that his children might beget in their turn only *after the Deluge*, and his pious fathers all disappear by death *before* its occurrence. He directs attention to the fact that Methuselah died at 969, the year of the Flood, and that adding together 187 (the age of Methuselah at the birth of his first son), 182 (the corresponding age of Lamech), 500

* J. S. Mill : A System of Logic : Vol. ii. Book v. : chap. iii.

† A survival exists in our modern paraphrase of "If anything should happen to you" in place of "if you should die."

‡ The Composition of the Book of Genesis, p. 156.

(the similar age of Noach), and (Chapter vii., v. 6), the further 100 years elapsing in Noach's life before the Deluge arrived, we obtain the number 969 !

The declension of the Patriarchal ages is attributed, in the Hebrew Scriptures, to the effect of unrighteousness, for, after the Deluge, the ages successively diminished to 148 until they reached the pathetic 70 of the Psalmist. The constant conception and hope of the Hebrew Race was the gift of prolonged life as a sign of Divine favour, and hence it was a natural feeling which prompted them, in evidence of this gracious approval in the ancient and golden age of their story, to exhibit emphatically this symbolic attribute in the heroes of the primitive scene of their national drama. Mr. Grote* has described the altered sentiment occurring in Europe which,—while incongruent with the ancient myths,—involved a popular demand for narratives of a similar but modified type, and thus introduced the legends of the Catholic Saints and the Romances of Chivalry, corresponding to the saintly-ideal and the chivalrous-ideal forms of character. And he points out, as a necessary element of these conceptions, that the holy men thus eulogised from the 4th to the 14th century were invested with attributes tending to assimilate their moral features to the supreme prototype of Jesus Christ. In an analogous manner, as I have stated, the deep National craving for long years of individual life, as an incontestable criterion of the beneficent regards of the Almighty, was inevitably transferred, in the popular legends, to their ancestral Patriarchs, who were assumed pre-eminently to enjoy the Divine benediction. The sign must accompany and seal the fact; the essential attribute must glorify, in an intensified mode, the distinctive recipients of Jahveh's grace. In Genesis, old age is constantly regarded as a Divine and special gift; and, in the writings of Isaiah and Zechariah, those communities are counted to be highly favoured which numbered multitudes of aged people among their members. According, indeed, to Rabbinical writings, Enoch and Elijah are extreme typical instances of the association of longevity with innocence and Divine approbation, for they were not permitted to die by reason of their sinlessness.

* A History of Greece : Vol. i.: chap. xvii.

The contention, therefore, cannot be resisted that the conjoint influences I have described have possessed a share,—a predominant share,—in the formation of these exaggerated ages, though, obviously, the *general* character of the process can alone be indicated, without any detailed analysis, or proportionate distribution, of the several elements of which that character was the combined and accumulated expression.

VII.—PRIMITIVE METHODS OF NUMERATION, AND THEIR INHERENT TENDENCY TO ERROR.

I proceed now to other considerations, of an equally important weight, relating to the transmission of the Hebrew records to historical times.

In all Nations, the Hebrew included, the primitive methods of numeration, after a system of writing had been established, were based upon the employment of the alphabetic signs for figures.

Before the epoch of Mohammed,* the Arabs possessed no numerals, and numbers were expressed in words. The practice then gradually became prevalent of utilising the Arabic letters of the Alphabet to signify numerals, in analogy with the system adopted in Greece. The ancient Greeks also† expressed numbers in either writing or words,—a universal custom. The Roman symbols‡ for numeration were generally the initial letters of the names of the numbers: C for *centum* or 100. Similarly in Attica, 5 was denoted by π for *πέντε*; 10 by Δ for *δεκα*. This clumsy, though intelligible, practice was abandoned in the 3rd century B.C. by the Greeks in favour of what is termed the "Alexandrian" system, where the numbers 1 to 9 are represented by the first nine letters of the Alphabet. I submit a few letters of the Hebrew alphabet,§ with their numerical equivalents for comparison. י (yod)=10; ו (vav)=6; ר (resh)=200; ד (daleth)=4; כ (caph)=20; ב (beth)=2; ג (gimel)=3; נ (nun)=50; ה (he)=5; ח (cheth)=8. The intimate similarity

* F. Cajori : A History of Mathematics, page 102.

†‡ W. W. R. Ball : A Short Account of the History of Mathematics : chap. vii.

§ Gesenius : A Hebrew Grammar.

in form between different symbols is very marked; *yod* and *vav* present only the variety of length of tail; *resh* and *daleth* differ merely in the rounding of the angle; *he* and *cheth* can be rendered identical by a slight prolongation in one of the strokes. The perplexity is increased when variations of numeration are obtained by superimposed points over the signs. For example, *y* (*ain*)=70: now, when two points are placed over *ṣ* (*nun*)=50, the modified letter *ṣ̣* signifies 50,000,—the addition of the dots indicating multiplication by 1,000,—and it is obvious how readily these two letters might be confounded on account of the marks over the latter symbol being similar to the two upper hands of *ain*. This confusion has actually occurred*; for, in the Hebrew text, the number in I Sam., vi. 19, is 50,070; the Syriac and Arabic present 5,070; while five MSS. contain 70, which appears to be the correct reading. It has been conjectured that at first *y* (=70) existed in the text; that some scribe discovered *ṣ̣* (=50,000) in another copy, and either placed it in the margin or incorporated it into the body of his MS. It might be added that, in composite numbers, the larger are placed first. An extended array of analogous confusions in the Hebrew text, due to the substitution of similar letters in the exhibition of numbers, might be recorded.

VIII.—ERRORS INCIDENTAL TO WRITTEN COPIES OF RECORDS.

I need not emphasise the fatal certainty of inaccuracies being thus produced, after the introduction of writing, in the copying of manuscripts expressed in a clumsy and difficult system of alphabetic numerical signs; while, adverting to the anterior period of oral transmission, when traditions were solely conveyed from age to age by speech and memory, it is obvious that, notwithstanding the fact that the native retentive power of memory is marvellously developed by habitual use without the assistance of objective symbols, mistakes and corruptions must have perpetually occurred, especially in the transference of numbers where no social, or linguistic or mental relation

* Kitto: *Biblical Cyclopædia*, s.v. Number.

naturally existed between the different elements which, if such a connexion had subsisted, would then, by the mutual play of Association, have tended to preserve, in their literal integrity, the relations so uniting the different ideas or notions thus welded together. I refer to the *exact* retention of the *individual* numbers, not to the conception of mere *magnitude* which might be maintained though the numerical expressions of that magnitude might vary from copy to copy. It is clear, further, that, if any mnemonic device can be instituted by which the numerals can be approximately conserved in memory, such an expedient would necessarily, or generally, be resorted to as a bond of adhesion between the figures which the oral tradition contained. Indeed, for the comparatively accurate retention of disconnected numbers, some artificial scheme becomes imperative in securing a reasonably exact transmission. And one form of this mnemonic mechanism is exhibited in the doctrine of the several numbers being the embodiment of a mystic number, or a combination of mystic numbers, universally acknowledged and accepted, to which the actual figures are constrained or adjusted. A memorial chronology, accordingly, will be generally discovered in the numerical records of primitive traditions. And, remembering the sense of importance which was attached to the primary necessity of preserving the *broad* characteristic facts and features in harmony with the *general* and supreme truth to be conveyed, and the undeveloped conception of precise historical accuracy which then prevailed, it is natural to observe that alterations of recorded numbers would tend,—readily, and without any intention of deception,—to be introduced if the designed effect were thereby facilitated and confirmed of impressing rather the *significance* of the numbers than their *literal* exactness upon the popular imagination. Dr. H. E. Ryle,* Hulsean Professor of Divinity in the University of Cambridge, suggests that the numbers 7 and 10 (expressing the seven names in the genealogical list in Chapter IV. of Genesis, and the ten names mentioned in Chapter V.) formed a mnemonic scheme towards rendering the lists more easy of preservation in memory. And even, in the Old Testament Commentary,† it is admitted that the earlier genealogies of mankind were probably of

* The Early Narrative of Genesis : chap. vi.

† Edited by Dr. E. J. Ellicott, Bishop of Gloucester and Bristol.

the nature of a *memoria technica*. It is evident, further, that this attempt to assist the memory would be vastly strengthened if, as appears to be the case, the devices employed were based upon the adoption, as memorial aids, of numbers which were universally regarded as of sacred and intrinsic import.

This inevitable susceptibility to error, incorrigible in oral records, was again augmented, as I have stated, when writing was introduced, by unavoidable confusions in transcription, and by additions to the text, or modifications, casual or intentional, by the copyists of manuscripts,—most of them the accidental results of inattention, weariness, monotony, or lack of intelligent appreciation of the subject or language; some, the suggestions of a lively mind supposing itself capable of restoration or explanation where the text appeared to be defective or obscure; while others have no doubt possessed an intentional character introduced for the purpose of conciliating certain expressions in the work with the prevailing ecclesiastical conceptions of the age, or with the personal bias of the copyist or commentator. A comparison with the Samaritan, and Septuagint Version, relating to these Patriarchal ages, which I have inserted in the Note on page 54, affords an example on this particular point.

A portion of the critical apparatus applied to all ancient manuscripts consists of a schedule of the several classes of mistakes and corruptions to which the copies of the original are in succession and inalienably liable. The facility of error would be increased by the stages of linguistic variations; by changes in the form of words; and modifications of their historical meanings, which all varieties of speech present as they develop under the influence of fresh modes of thought, augmentation of knowledge, and the inherent processes of Generalisation and Specialisation of terms, so that an error, or confusion, or misconception, once originated, tended to become wider and more erratic from the original utterance with the progress of the vicissitudes of language, due to the effluxion of time, the alteration of forms of feeling and mental standards, and the nature of customs and usages varying from age to age. Tennyson on one occasion lamented the continuous development of the Anglo-Saxon speech as likely to consign his poems to the custody of an archaic stage of expression, and, therefore,

* M

requiring verbal reconstruction and interpretation, just as the evolution of British forms of language has relegated Chaucer to the region of classics in the sense that he is only intelligible, by the aid of a glossary, to modern perception and enjoyment. A similar principle, of course, applies, *mutatis mutandis*, to numerical scales and units.

IX.—THE HIGHER CRITICISM, AND THE COMPOSITION OF THE HEXATEUCH; WITH THE INVOLVED PROBABILITIES OF ERROR.

The method of linguistic interpretation, which is now styled the "Higher Criticism," may be appealed to in studying the prolonged history of written tradition prior to fixation into its existing form, and the adequate space thus afforded for the introduction of confusing, conflicting, and erroneous elements. This branch of Hermeneutics embraces the province of determining the origin, date, and, especially, the literary structure of a writing.* In many subtle and minute particulars, no doubt, this species of enquiry possesses too strictly a subjective character,—varying with the native and acquired tendencies, prepossessions, and culture of the individual investigator,—to justify a complete and final acceptance of all its professed conclusions; but, unquestionably, by a precise examination and analysis of the several styles of speech, modes of thought, literary forms, and adoption of the usages, local or general, of the period which each composition reveals, it has produced a system of important and permanent results. When the composite nature of the Hexateuch is dissected in this manner, different strata of composition are distinctly distinguished and accurately dissolved; and we further find that the apparent unity of a text,—apparent to the superficial and untrained eye,—is not the product, intellectual and historical, of one original writer, but forms a combined unity only, achieved, and generally mechanically achieved, by a subsequent redactor or redactors, who roughly and often inartistically welded together,—or rather, more strictly speaking, mechanically joined,—into one somewhat incongruous narrative, the

* Appendix to an Introduction to the Literature of the Old Testament, by Dr. S. R. Driver.

parallel or similar stores of tradition, or pre-existing documents, which were available as various sources of an anterior period.*

The Book called Genesis, or rather the sources of which it is constituted, does not consist of a single original work, but it is found that older extant writings or sources have been conjoined by an Editor or Editors, which, by the application of this method of Exegesis, are capable of being distinguished from each other. The compilers of the composition entitled Genesis, or the Book of Origines, as it at present exists, have followed the custom adopted in the construction of all original traditions, and have excerpted from the several primitive sources those portions which, from their moral or intellectual or ecclesiastical or social point of view, appeared to be suitable to the purpose they intended ; simply, however, according to the analysis of the Hebrew text, intertwining and incorporating these extracts as they existed in the earlier records,—sometimes, too, inserting additional matter as glosses of their own,—without incurring the literary labour of expressing these elements in their own language and knitting them together into a homogeneous and harmonious style of narrative. The several parts which compose their story are mechanically united instead of being fused into a systematic and,—with reference to style, or form of consistent literary construction,—a coherent and organic linguistic unity. The Book of Genesis thus presents, side by side, a group of sections differing between themselves in phraseology, character of style, and, frequently, exhibiting *concomitant* variations of representation.

The two important portions of Genesis (after the separation of the parts which more immediately concern our enquiry), have been formed by the combination of primitive and originally independent sources which were subsequently united by an Editor : one of these sources or documents is designated J, from its preferential employment of the term Jahveh as the name of God ; the other is denoted by E, on account of its exclusive use of the term Elohim ; and these two were, at a later era, woven into one work, which is distinguished as J E. Another independent source, with which we are more particularly dealing, and which includes Chapters v. and xi.—containing the Patriarchal ages—is described as P, from the peculiarly Priestly

* Dr. S. R. Driver: An Introduction to the Literature of the Old Testament : chap. i.

character of its narrative. And, at a subsequent stage, the clearly definable and distinct documents, J E and P, were welded together by an additional Redactor, who adopted P as the ground-work of his History, and accommodated to it the sections J E, with omissions and editorial adjustments. Now, the source P* appears to be posterior to the age of Ezekiel, 500-475 B.C., and consequently less remote in date than both J and E, neither of which is later than *circ.* 750 B.C., and possibly the epoch may be assigned to the time I have just named. Dr. Driver† points out that the chronological scheme adopted by P appears to have been deduced by him by *calculation* from unknown data, which must in part be possessed of an *artificial* character: his figures, adds Dr. Driver, cannot be altogether historical, but seem to be obtained by a method of computation in some manner which cannot be ascertained or conjectured.

X.—SUMMARY OF RESULTS.

It is obvious then that the sources of Chapters V. and XI., which embody the legendary record of longevity of the Patriarchs, have been of precarious and uncertain origin and history; modified in a degree upon some artificial mnemonic scheme, and, considering the origin of these documents, their vast period of transmission, and their late compilation, ample time and scope were afforded for the intrusion of errors, incongruities, and exaggerations.

It is hardly needful to repeat that, concordant with the primeval traditions of all peoples, the mythopœic faculty is ever in luxuriant play in exalting the memory of vanished heroes, and investing them with the aureole of unprecedented power and honour as expressed in the loftiest and most persistent forms of excellence which the Race may cherish as its supremest types. In the Hebrew nation the noblest ambition and most eager desire consisted in the Divine favour, extended to individuals no less than to the National unity they composed; the eminent symbol of that Grace resided in the grant of prolonged life; and, hence, by a spontaneous and necessary tendency, the ascription of legendary and extraordinary ages to the august

* Driver: Op. Cit.: chap. i. § 6. Fripp: Op. Cit.: p. 3.

† Op. Cit.: chap. i. § 7.

ancestors of the community became perfectly natural and inevitable, as exhibiting in a duly proportionate and enhanced degree the significant approval which they enjoyed from God. Myths follow regular processes in their introduction and evolvment ; and, among the universal characteristics of all National stories, they belong to the earlier periods of human history,* and tend to glorify a people, or the origin of that people, and the illustrious men who have adorned it and have pre-eminently elevated their kindred above the frailties and limitations of the Race. Hence, summarising the preceding considerations and results,—the individual application of which, as they were successively discussed, I have rather left to the reader's thought,—and looking to the oral origin of all traditions ; the changes in the forms of numerals or of alphabetic letters employed as representative numeration ; the confusion to which all similarities of pictured signs are subject ; the lapse of memory through which the tradition long filters and is perpetuated ; the incessant and inevitable introduction of mythical accretions ; the variations in the forms and significance of words, to which all languages are destined ; the scribal errors incidental to copies, especially when inscribed in clay, stone, or picture-writing ; the loss or abrasion of the fineness of chiselling and of the distinctiveness of symbols, to which early Tablets of this composition were liable, even under the undisintegrating air of Palestine ; the accidental and deliberate insertion of alterations and additions to the text when reduced to writing, conjoined with the occurrence of omissions ; the incorporation of marginal glosses and comments into the integrity of the original story ; the adjustment of sections or statements which appeared discordant from the personal or National conception of what the narrative was imagined to be intended to convey, and the modes of its presentation ; the ascription of all that was noble or memorable or unique to the ancestral records and to famous forefathers, produced by the irresistible tendency in man to elevate the past ; the investment of ancient and eponymic heroes, supposed to be supremely honoured by the Deity, with those eminent and specific marks of that favour which the genius of the Race spontaneously accepted ; the ineradicable errors in manual transcription of writings prior to the advent of

* Dr. Samuel Cox : *Miracles : An Argument and a Challenge* : chap. ii.

printing ; the complete incomparability, with any approach to reasonable exactitude, between the modern methods of chronology and the varying schemes adopted in the legendary periods of the world—regarding, I repeat, these accumulative sources of mistake and confusion, inseparable, in the history of human frailty, from the perpetuation of primitive and original traditional records, it is not a subject of wonder that the final result of investigation must be that credibility cannot be attached in any degree to these alleged and exaggerated ages of the Antediluvians. And this conclusion, deduced from the classes of considerations and data which I have described, is amply confirmed and verified by the results of Geology and the Natural Sciences in general, which have rigorously proved that, so far as keen and cultivated scientific enquiry can extend, a definite continuity of experience has been discerned through all the ages of time, both in the domains of physiology and physics. The investigations of Geology, with its fine teaching—consistently significant of the methods of the Almighty in both objective and subjective Nature—of graduated uniformity of action, over spacious periods, through the operation of the simple natural forces which at present change and modify the features of the Earth,—so ably and exhaustively exhibited by Sir Charles Lyell,*—clearly indicate that no Universal Deluge then occurred ; its labours are assisted by the concurrent and harmonious doctrines of Astronomy and the various Physical Sciences in demonstrating that no abrupt alteration separated the modern from the ancient world, or the existing relations of the Universe from those which previously prevailed ; the researches of Physiology can detect no solution of continuity in the structure of the human frame or the general conditions of terrestrial life and environment, which would legitimately assign an immensely prolonged existence to the primitive races or individuals of mankind ; while the discoveries and methods of Philology, and of Literary and Historical Criticism, add their contributory results, and conclusively reveal the persistent and universal sources and certainties of error in the transmission of aboriginal records during the lapse of changing and protracted eras of time.

* The Principles of Geology.

CHAPTER V.

VARIOUS REFLECTIONS, SPECULATIONS, AND RESULTS:
STATISTICAL AND PHYSIOLOGICAL.

I.—THE ORDER IN NATURE OF CASES OF CENTENARIANS.

Is it possible to discover the nature, order, and cause of these abnormal phenomena amid the general compass and uniformity of human life? Are they, in the language of Natural History, mere "sports," thrown off irregularly or sporadically as excrescences of Nature without conformity with any scale of order,—so few, that prediction, from the insufficiency of data, is unfeasible; so discrepant, that they are incapable of being even approximately confined within any conception of Law; or do they indicate a definite cause or causes, and constitute exhibitions of a special uniformity as yet unexplained, but competent—from such partial glimpses as we secure, and congruently with the general formula of Nature's consistency of action—of an ultimate classification in accord with the systematic and connected processes of Force; are they the fragmentary or rare expressions of a factor or factors whose nature and correlations may be associated with the more customary and evident range of Nature, which scientific and statistical enquiry, on ampler bases, may yet be able to disclose? Do they present the signs of Nature's exuberance of vitality, or the symptoms of a disorder which she occasionally displays?

II.—A MATHEMATICAL ANALOGY.

Consider a Mathematical illustration. The analytical expression* of a certain re-entering Curve of four dimensions, involving variable and constant quantities, presents, when numerical values are inserted in the equation, a specific and continuous outline. By a slight change

* C. Babbage: *The Ninth Bridgewater Treatise*: chap. viii.

in the value of the constants, the form of the Curve is modified, and two loops become apparent, standing out from the Curve, yet still in continuous conjunction with the main portion of the figure. A further alteration of the constants effects a discontinuity between the parent outline and the two loops, which then assume the form of separate and disconnected ovals; while another modification in the values of the constant quantities reduces the ovals to two points (invisible to the eye, but perfectly cognoscible by the geometric vision), absolutely independent of the continuing curvature, and apparently existing as isolated or singular points in space. But though they present this uniquely distinct position, they are as intimately involved in the mathematical equation from which they are derived as the flowing line itself; and the integrity of the Curve is shown to have suffered no solution of its inherent form. The law or uniformity of progression in space, implied in the analytical equation, is revealed by the coalescence, in its absolute or essential formula, of these apparent exceptions and equally of the fluent shape itself.*

It is most probable, in consonance with the universal regularity of Nature, in all its several departments of physical and, indeed, mental expressions, that these demonstrated instances of abnormal longevity (or deviations from a central norm which extensive data invariably display) are included, vitally and inherently as the remaining and more constant phenomena, in the Equation of Life.

III.—DIVERGENT EXCEPTIONS IN NATURE.

In all physical observations, which Science has investigated, aberrant instances are discovered. Professor Stanley Jevons† has enumerated eight classes of exceptional phenomena which may be traced in more or less detail in physical enquiries, and which may—with a probability ascending in scale, as investigations more minutely and precisely extend, to the superior limit of approximate certainty—be subsumed under some ampler generalisation of uniformity, or be exhibited as the direct, though obscure, result of a general law, or as

* The equation is : $y^4 - 4y^2 = -ax^4 + bx^3 + cx^2 + dx + ex^0$.

† The Principles of Science : chap. xxix.

the consequence of special laws which may ultimately be merged or allied with larger principles. Some exceptional cases, as in Mineralogy, are ascertained to depend on misapprehension of the circumstances so that the necessary rectification removes the seeming divergency; others (as the total reflection of light between denser and rarer media) are shown to be apparent exceptions only when an adequate explanation is supplied from the general Theory itself; others are dependent on the subtlety and complexity of the general law which, when more exactly determined in its ramifications, provides the solution of the divergent problem, and enables these examples to be symmetrically ranged within the uniform scope of the law itself; and others may reveal the existence of uniformities, previously unsuspected, and correlated with the more universal rule already discovered and generalised.

When the laws of Nature have assumed a precise quantitative numerical condition, we may anticipate the occurrence of singular instances, and as the whole of the Physical Sciences meet in the mathematical principles of mechanics, it will be found that no portion of Nature is devoid of these apparent anomalies. They present, however, no contradiction to the prevailing constancy of phenomena, but, on the contrary, may afford the most unique opportunities for the final verification of the uniformity itself.

The instances of excessive longevity belong, apparently, to the class of Divergent Exceptions, in which a phenomenon manifests itself in a character of unusual magnitude without being subject to a peculiar law appertaining to the specific class itself. Like the parallel illustrations of giants and dwarfs, the Centenarian exceptions constitute no mere *lusus Naturæ*; and it may be assumed that, corresponding to other natural abnormalities, the order or frequency and significance of their occurrence are intimately coincident with the law of error or divergence from an average. They will in due time be rationally ranged among *aberrant*, but not *arbitrary* examples; their apparent *lawlessness* will be comprised within the scale of a uniformity of *rule*; and, though *eccentric* in their movement, yet bound by a natural and simple tie to the Centre and Norm of the vital Universe.

IV.—THE PROBABILITY OF ERROR CURVE.

M. M. A. Quetelet, in his *Statistical Enquiries*,* regards Nature as seeking to establish certain standards of value or types of form from which these exceptions are deviations, and constitute indications, indeed, of the norm from which they diverge. In giants and dwarfs, I may add, we perceive a deviation in space; in Centenarians, a deviation in time. Observations, M. Quetelet remarks, prove that the stature and other properties of the human body are regulated by the law of the probability of error, where that probability forms a function of the error in question; and the various groups into which the different characteristics of mankind may be classified, are divergences, in accordance with the Law of Probability Curve, from the mean proportion which Nature aims at producing. The facts of longevity are clearly embraced within this mathematical scheme, but they are too scanty, complex, and precarious, in the present state of knowledge, to enable us to assign, with any precision, the conditions on which these irregularities depend. The factors of human life are not merely intricate in themselves, but also exhibit a complexus of complexities; the personal constitution as affected by the varying intensity of heredity, by natural physical vigour, with mental and moral elements, and their comparative distribution in reciprocal extent; by individual training in addition; and this totality is associated with the external factor, the ever-changing material environment which incessantly and fundamentally modifies its co-operant factor. The reader will here recall the famous proposition of Mr. Herbert Spencer† that perfect correspondence between an organism and the environment would constitute perfect life. Were there no changes in the environment but such as the organism possessed adapted variations to meet, and were it never to fail in the efficiency with which it realised this adjustment, eternal existence would result. This formula expresses essentially the principle,—though, necessarily, from ignorance of the conditions on which it minutely depends, it exhibits but an abstract form—which underlies the question of longevity.

* *Letters on the Theory of Probabilities*: Letter xxi.

† *The Principles of Biology*: Vol. i.: chap. vi.

The modes of expression adopted by Quetelet and some other writers do not appear to me to be precisely accurate. They might be accepted to imply that the attempts of Nature (to employ the customary term for the forces, and their correlations manifested in the Universe), to create particular types were attended by repeated failures, as shown in the individual deviations from an average form. To assume that a mean result, which is the subjective mode of viewing and classifying phenomena obtained from scientific research, represented a corresponding objective feature in Nature, would present the form of the recurrent fallacy of many Schools of Philosophy that subjectively unifying notions and relations necessarily indicate exact analogues in the objective physical system. Certainly the forms of language employed in describing these cases,—*ab-errant*, *di-vergent*, *ex-cessive*, *ab-normal*—all implicate, in no sense an *un-natural* condition but, simply a digression from some, it may be indefinite, standard. But, to repeat in other words what I have just remarked, verbal distinctions are subjective modes of classification for mental convenience,—and, indeed, as a postulate of co-ordinated knowledge,—and to infer the necessity of corresponding and responsive differences in Objects would embody the persistent error of assuming that representations in the mind are the absolute copies or guarantees of analogous external facts. I should rather be disposed to state that the circumstance of our observations exhibiting ranges of divergence constituted a mark of an orderly scheme of connexions in Nature, whose deviation from the generally suggested uniformity would be ascertained and unfolded when our mental vision had become sufficiently clarified into keen and disciplined power.

In the mathematical doctrine of Probabilities we find the term "error" denoting those accidental deviations from an approximately fixed standard which are produced by the intermixture of numerous causes whose effects are incapable of being ranged within the scope of physical investigation ; and the Curve of Probability is founded upon three axioms* of experience ; namely, that positive and negative errors are equally frequent ; that minute errors are more numerous than

* M. Merriman : The Method of Least Squares : chap. ii. : The Law of Probability of Error.

large ones; and that very considerable errors are impossible, or that the probability of their occurrence is practically zero. Having regard to the specialised definition of "axiom" in metaphysical speculation upon the fundamental structure of geometry, I should myself prefer to substitute, for Professor Merriman's expression, the more appropriate phrase of "inductions from experience." If, in our enquiry, we employ the term "extreme or rare deviation from a central (though somewhat varying) form" in place of the phrase "impossible," the Centenarian instances may be regarded as extreme divergences from the mean in the *positive* direction. But as deviations in one direction are correlated with divergences in the opposite, or *negative*, region, where shall we discover the counterbalancing or compensating limit to Centenarian examples, and thus produce the polar symmetry? The speculation occurred to me that the negative correlate to Centenarians would properly be placed in the antenatal deaths, or deaths *in utero*; the extreme of longevity *beyond* the termination of ordinary life finding its opposite in the extinction of life at the epoch *prior* to the observable origin of the series,—the point of living birth. Is this supposition theoretically feasible? And the connected question naturally occurred whether a period distinguished by proportionately numerous instances of abnormal longevity was probably correlated with a stage when the frequency of antenatal deaths,—the polar and negative extreme,—happened to be excessive. I pondered over this aspect without obtaining any reasonable confirmation of the notion when I had the good fortune to study the able and instructive Essay by Professor Karl Pearson upon the Chances of Death,* which apparently affords a theoretic support to my general conjecture. For, removing from his total Death Curve,† the mortality sections appertaining to old age, middle life, and youth, he obtained a remaining curve of a strange-looking character, though resembling in its general features the Frequency Distribution curve which prevailed in so many and apparently incongruous classes of data. The mechanism for effecting a continuous juncture of this segregated Curve with a theoretical Frequency Curve was long impracticable; but, finally, he succeeded,—

* The Chances of Death, and Other Studies in Evolution: Vol. I.

† Page 73.

by considering (i) that the mortality of childhood is distinct from that of infancy, and (ii) that the mortality of infancy must, at least in theory, be extended across the antenatal period to a distance which is, very approximately, nine months,—in discovering that the Curve theoretically required the assignment of an origin at a point nine months preceding birth. And, although statistics are deficient on the subject, (except to an extent in respect of still-births, which may be regarded as appertaining to the last three months of the antenatal stage), Professor Pearson found that the antenatal deaths to each 1,000 born alive were reasonably confirmed.

I admit that my specific surmise is not yet determinable under our existing systems of statistical enquiry, and I leave it, therefore, in the region of speculation.

I cannot refrain from expressing my admiration of Professor Pearson's reference, which affords another remarkable example of the striking manner in which Theory, dealing with a continuous quantity, is competent of suggestions which ordinary observation would fail to note.

V.—THE LAW OF LARGE NUMBERS.

I have described the cases of extraordinary longevity as belonging to the order of Divergent Exceptions; and the enquiry naturally arises whether any means are possible for their reduction to Law. Prolonged and consistent observation in every department of phenomena reveals that the modern conception of chance is radically different from the ancient and prescientific view; so that the conclusion is universally entertained that, in the region where chance is supposed to reign (if, indeed, we can assign any definite meaning to what is termed chance), regularity and orderly progression will, with extended and minuter investigation, be discovered to reside. Chance, as Professor Stanley Jevons* remarks, does not exist in Nature and cannot co-exist in Knowledge; it is simply the statement, as Laplace observed, of our ignorance of the causes in operation. It can then reasonably be affirmed that verified instances of longevity, occurring at all periods

* The Principles of Science : chap. x.

and in all communities, are the subjects of some law or laws involved in the general law which regulates human existence. And, consequently, the possibility of detecting these uniformities depends upon the extent of the appropriate area in which they occur. James Bernouilli's Law of Large Numbers here, and universally, applies,—that by multiplying sufficiently the number of trials, the difference between the results of calculation and of experience may be restricted within ever-narrowing limits.

In Buffon's well-known trial, a coin, dynamically exact, was tossed 4,040 times, and 2,048 heads appeared to 1,992 tails; and, in a similar experiment by a pupil of De Morgan,* the heads were 2,048 against 2,044 tails in 4,092 throws. In so apparently casual a process as the tossing of a coin, whose results are so irregular in a few sets, we perceive the constant tendency to equality of occurrence, which raises the presumption that, in an infinity of throws, the events would precisely agree. Professor Pearson† himself found that, in 12,000 tossings of a coin, the successes, or occurrence of tails, were 50·16 per cent, while, when the experiment was extended to 24,000 trials, the successes showed the closer equality to heads of 50·05 per cent. I might add, too, that measurements of man by Mr. Galton, measurements of crabs and shrimps by Professor Weldon, and the examination of human cephalic specimens by Professor Pearson, disclose the fact, when extensive numbers are involved, that the apparently random sizes of organic objects possess a frequency closely corresponding to theoretical Curves of Frequency.‡

In our especial subject, numerous and interacting forces are in concurrent operation, such as those concerned in human life, and it is obvious that we shall only arrive at reasonably approximate results in proportion as the extent of our discriminated observations is widened. Hence it may be anticipated that enlarging scope of survey, perfected by the Methods of Science, will disclose a uniformity in

* Formal Logic: chap. ix.

Jevons: The Principles of Science: chap. x.

† The Scientific Aspect of Monte Carlo Roulette. (*The Fortnightly Review* for February, 1894).

‡ The Chances of Death; and *vide* page 72.

Centenarian examples which a recognition of the permanent regularity of all Natural phenomena on an ample scale warrants us in expecting. For as Dr. John Venn* has expressed it, the vaster the "crowd" out of which our instances are selected, the closer the approach to distinct uniformity.

VI.—THE POSSIBLE CONNEXION BETWEEN THE LENGTH OF A GENERATION, AND THE NUMBER OF CENTENARIANS: A DISTINCTION SUGGESTED BETWEEN TWO KINDS OF A GENERATION.

The interesting question then presents itself of the possibility of any organic connexion between the duration of a Generation of men at any stage, and the proportionate number of abnormal instances of longevity. Are these more likely to occur amid a Generation which, by reason of various causes, possesses a larger average period of existence, and a greater proportion, therefore, of aged persons; with a diminution of cases where the length of Generational life has become reduced? The inference from statistics would seem to suggest that the average duration of a Generation is in some mode correlated with the proportionate exceptional instances, if on no other ground than the fact that in a Generation of unusually protracted term, a wider opportunity would be afforded for the existence of a superior number of old persons from which an increased ratio of extreme examples might arise,—the ampler area of general longevity forming a more extended arena for the production of abnormal exceptions. Would not the proportion of Centenarians be connected with the magnitude of the data out of which the divergencies occur? If so, we might reasonably expect to discover a periodicity in the scale of aberrant or surplus deviations, just as a cyclical order of Generational life may be anticipated in all average results. For my suggestion is that not the *amplitude* of a Generation is the requisite datum for expectation of a superior ratio of excessive cases, but an *extended* Generation where the proportion of aged people, who do not themselves attain 100 years, is more than customarily high, and furnishing, accordingly, a wider

* The Logic of Chance: chap. i.

appropriate sphere, afford a correspondingly increased occasion to secure a larger proportion of extremely prolonged lives. The suitable condition, therefore, to propound the proposition differently, is not so much the *extent* of a Generation in *space*, as of a Generation in *time*; or, to borrow the nomenclature of logic, a form of Generation whose character is *intensive* (implying quality) rather than *extensive* (involving mass). This proposition is simply another mode of expressing the established canon that large numbers are requisite if *all* existent uniformities are to become disclosed, and, especially, is this primary condition to be postulated in observations where,—as in human life with relation to the extreme instances of Centenarian phenomena,—a profound and intermingled variety, and complexity of interdependent causes are in simultaneous operation, with their intricate relationships and mutual modifications, which demand accordingly the most spacious possible compass for their complete expression, and the manifold exhibition of their several and connected effects. I might suitably and varyingly indicate the distinction in Generations,—vast quantity or conspicuous quality,—by the correlated terms of Dimension or Duration; Extent in Space or in Time; Area or Linear Range; Mass or Prolongation.

It is evident, moreover, that an enlarged proportion of aged persons in a Generation would be indicative of a more than usually substantial and diffused fund of life in the community, and hence would form the basis and ground of expectation of that general vitality becoming particularly pronounced in some individual instances.

It can be arithmetically shown that an enhanced average expectation of life in any Generation may exist which shall be consistent with an expected duration shorter than usual of *adult* lives; the greater survivance of life in infancy may so influence the general duration, that the average length of existence of the mass may be extended, while, concurrently, the average expectation of the older persons may be, in reality, inferior to the ordinary experience.

The requisite condition, therefore, *cæteris paribus*, for the probable exhibition of exceptional Centenarian cases, consists of a Generation of men which displays, not an unusually extended *average* duration of life on the whole, but one which contains an increased proportion of

aged lives. I submit the proposition without, however, having been able to obtain the confirmatory evidence of statistical facts,—not because I despair of discovering that foundation, but simply because the facts, under existing methods of observation and tabulation, are too difficult, intermixed, and complex to examine and disintricate with the necessary minuteness. It is evident, I think, that in a Generation of comparatively brief duration, any indication of excessive longevity may be due to accidental causes; may prove to be casual irregularities; and that it is only in an area furnished by a Generation possessing a high ratio of advanced ages that we can discover the feasibility of tracing the Divergent Exceptions of Longevity to uniform and constant causes. And, pursuing this train of theoretic conjecture, it may fairly be assumed that a Generation of extensive compass,—*i.e.*, a Generation of mass in number as distinguished from one of length in time,—will probably be followed by a Generation of inferior dimension but of enlarged extent in duration. In a numerous Generation, the struggle of life necessarily assumes an intenser character; the existing and available store of suitable physical conditions, including food, becomes more limited in relation to the increasing demand; the deepening conflict tends to produce neuroses and other grave affections which reveal their existence in the reduction of vitality and the disappearance of the enfeebled and incapable; while the survival of the fittest in those most adequately adjusted, by inheritance, native constitution, and acquired capacity, to the intensified conditions of existence,—though not necessarily the fittest in any supreme and elevated sense,—transfers a progeny to enter upon a Generation where, from abstraction of masses by death, the circumstances of easier life are more pronounced. The sequent Generation of man, accordingly,—with reduced disproportion between the multitude of claimants and the imperative conditions of their existence,—enforced by the fact that they form the offspring of victorious ancestors and, consequently, tend to inherit higher qualities of endurance and persistency of life,—may be expected to contain the possibility of an increased proportion of persons who will attain old age and thus provide the source from which examples of Centenarian duration may be derived. Yet here, once more, may be remarked the possible and cyclical effect of this improved condition, with its diminished severity of strain, in relation

to the succeeding stage. Upon this aspect I would cite, as an illustration, the considerations adduced by the Economist, the Rev. T. R. Malthus,* in his criticisms upon the "Golden Age," pictured by W. Godwin, in his "Enquiry concerning Political Justice." Mr. Godwin, attributing almost all the vices and misery disclosed in civil society to human institutions, advocated a system of complete equality, where political regulations and the established administration of property should no longer prevail. Mr. Malthus assumed the realisation of this dream, and the imagined removal of every cause of social inequality and individual distress; all men then in the Generation are equal, and each enjoys an adequate share of the total possessions and material comforts: this state affords the punctually favourable condition for practically universal marriage; the rate of increase of population, freed from all restraining checks, whether Positive or Preventive,† would uninterruptedly proceed; the proportion of the necessaries of life to the advancing demand would diminish; competition, and the struggle for existence, with the dominant re-appearance of self-preservation, would gradually develop in intensity; and, with the fatal recurrence of attendant ineradicable vice and misery, the fabled age of Godwin would vanish into the ancient gloom, and desolation, and despair, from which it had transiently sprung. Mr. Malthus hazarded the prediction that, in less than an ordinary generation, the whole fabric, which Godwin endeavoured to erect, would ruinously collapse through the pressure of the simple principle of Population. The remarkable St. Simonian doctrine of Cyclical progression,—the alternating Organic and Critical stages as exhibited in social phenomena,—finds its analogue objectively in the duration of human life as displayed in the succession of Generations.

VII.—THE CONNEXION OF BACTERIOLOGICAL RESEARCH WITH LONGEVITY.

But leaving the speculation for affirmation or rejection by wider thought and fuller investigation, it seems sufficiently clear, from the

* An Essay on the Principle of Population : Book iii. : chap. ii.

† Malthus : Op. Cit. : Book i. : chap. ii.

considerations I have submitted, that the probability of occurrence of these extraordinary instances of longevity may ultimately be found to possess some approximately definite correlation with the proportionate number of aged lives included in a Generation, out of which they arise. A dominant element in the question of the duration of life, and the sequent probability of abnormal cases, is profoundly involved, I conceive, in the modern teaching of Immunity, natural and acquired, against Infectious Diseases. I purpose discussing, or rather expounding, the subject briefly, and I base my technical references upon an admirable and exhaustive Article by Dr. A. A. Kanthack, entitled "The General Pathology of Infection."*

I need not point out that the phenomena, of which this teaching is the scientific and methodic exhibition, are permanent factors of human disease and longevity in every age; while familiar illustrations of these truths are embodied in the records of those well-attested examples, which previous writers have adduced, in the forms of personal freedom from illnesses and of derivation from a long-lived stock,—specimens, therefore, of both native and acquired and inherited immunity.

Bacteriology has proved the microbic nature of almost all infective diseases; and, indeed, infectious diseases may be defined as the products of living pathogenic germs which intrude into the human tissues from without, and are competent, when so localised, of constant multiplication until they become either neutralised or resistless. The principal lesions and symptoms ensuing on infection consist of the toxic manufactures of these carriers of infection. This doctrine may be thus expressed: that the chief lesions are the result, not of the mechanical coexistence of these micro-organisms in the tissues, but of the metabolic† products of the organisms themselves. Bacteria not merely consume certain substances of the animal body for their own nutriment, but manufacture also various toxic materials which produce disease and death.

* Dr. T. Clifford Allbutt: "A System of Medicine."

† Metabolism is the continual molecular change in the complex and unstable compound known as Protoplasm. (*Vide* Geddes and Thomson on "The Evolution of Sex": chap. vii.).

A personal predisposition, or susceptibility to a disease, may be *natural* or *acquired*: and a natural predisposition may either constitute a property of a species, transmissible from parent to offspring,—an accumulating peculiarity embodied in the race,—or it may prove an accidental and uninheritable character of one or more individuals of a species, which is not necessarily transmitted.

And without entering here into technical details, it may be summarily stated that, within certain limits, every organism possesses special cellular mechanisms for resisting infection. Thus, as a specific illustration, the acidity of the gastric juice, and its adequate supply, may prove too powerful for the vibrio (screw-shaped form) of cholera; while the ciliated epithelium and the sensitiveness of the bronchial mucus membranes, with the germicidal capacity of the mucus, may protect the respiratory organs effectually against the intrusion of tubercle bacilli.

With regard to acquired predisposition, adequate means can be employed by which a resistant animal, *i.e.*, an animal whose constitution is naturally antagonistic to the infection, can be rendered susceptible to any particular infective disorder; in other words, a disease which is non-contagious to a certain species of animal can be made very contagious to certain members of that species, so that the natural resistance of an organism to a specific microbe can be surmounted by general or particular artificial interferences, and an acquired predisposition to the malady definitely established.

Regard tuberculosis; and the means of counteracting or avoiding its incidence in any individual instance: the *contagium vivum*, or bacillus, is too prevalent to be destroyed; the effective appliances involve the attempted removal of the ascertained causes which favour the entry into the system, such as fatigue, loss of blood, and insufficient nutriment. Defective hygienic conditions and exposure, for example, may render the individual susceptible: the preventive process accordingly must be devoted to neutralising these causes of acquired receptivity; and, with these arrangements and the instant destruction of the sputum, the liability to death from consumption may be largely opposed.

An acquired sensitiveness to the action of tubercle bacilli may thus be successfully, in a large number of cases, cancelled ; while, in instances of personal predisposition, the recognition of the micro-organic factors of disease, the knowledge possessed of their action and modes of activity, and the countervailing resources of medical research, involve hopeful expectations of the neutralisation of this tendency.

In contradistinction to predisposition stand the related phenomena of Immunity, Natural and Acquired. The former is an innate inherent property of the constitution of the individual or species which cannot, apparently, be transmitted except by heredity, while the latter is capable of ready transference from one individual to another by serous injection. While natural immunity may, on the one hand, be personal or peculiar, it may, on the other hand, appertain to all the members of a species or race ; and it is a justifiable procedure to comprise racial immunity, to an appreciable extent, within the compass of an acquisition through Natural Selection and Inheritance. A large proportion of individuals naturally gifted with a superior degree of resistance to disease, would tend to survive in the incessant struggle with death, and since the properties to which their survivance was due were helpful and useful to the continuation of the species, these qualities, in accordance with Darwin's well-established induction,* may be assumed to be readily transmitted by heredity.

Many theories of Immunity have been proposed which I need not describe : it is sufficient to remark that an original susceptibility to disease may be converted into a power of resistance against a subsequent infection by (i) the natural susceptibility to it being, *ipso facto*, removed by the mere fact of recovery. This is Nature's formula that restoration from an acquired infection is followed by an increased capacity of effective opposition to sequent attacks ; (ii) an artificial power of resistance may be communicated by inoculation with the attenuated virus ; that is to say, by inoculation with the living micro-organisms or their spores ; or (iii), in place of employing this method of inoculation, small doses of living and virulent organisms may be administered to produce artificial immunity.

* The Origin of Species : chap. iv.

It has been shown also that some of the elements of immunity constitute a portion of the physical apparatus ; and that the tissues possess a naturally competent defensive and protective capacity of development into more effective service. Various modes thus exist of educating the reactionary vitality of the tissues and cells. The natural factors of existence, or forces of Immunity, will spontaneously destroy a certain number of bacilli, and, beyond that indefinite limit, disease will occur ; *i.e.*, the bacteria will secure preponderance of power ; but by the application of stimuli to the cells, the limit of innate Immunity may be augmented, and this assistance may be rendered by administering, in connexion with particular infections, repeated doses of the bacilli or their toxins ; so that practically the invaders are made to defeat themselves by their own weapons ; or the process may be a general one directed to all infections.

The discovery of Salmon and Smith has shown that Immunity could be provided artificially against an infection, not exclusively by bacterial vaccination, but by means also of chemical inoculation ; *i.e.*, by the introduction into the system of the toxins of the microbes. Until that discovery was published, it was assumed that artificial Immunity depended on the germicidal influences proceeding from the bodily tissues ; but, since this date, it is frequently sufficient to inject the dead bodies of bacteria in order to ensure protection.

It was then found by other investigators that an antagonistic power exists in the blood and serum, with a reactionary vitality inherent in the tissues and their cells. Thus the animal serum and blood possess signal properties in themselves. Fodor, in 1887, proved that the fluids of the body, and especially the blood, are germicidal, or destructive of bacterial life ; and hence results Behring's law that if an animal has been artificially protected against a particular infectious disease, its blood and serum acquire the capacity, when injected in adequate quantity into another animal, of directly transmitting an immunity from that particular agent of disease.

Buchner and Hankin assume that, in the condition of Natural Immunity, the blood, lymph, and tissue fluids possess a germicidal power, due to certain albuminous or albuminoid substances, secreted

by specific somatic cells; however this proposition may be fully established or not, it is clear, as I have stated, that the serum or plasma of the blood does contain these destructive elements. And these properties in question can be separated from the blood, spleen, and other tissues of most animals. Natural immunity depends, therefore, upon the vital reactions evoked into actual activity by the antagonism between the threatened tissues and the bacteria with their products, in which the destruction of bacterial life is assisted by the innate germicidal or anti-toxic properties of the serum, plasma, or lymph, and the phagocytic qualities of the "wandering" cells, as they are termed.

It is hopefully to be borne in mind that acquired specific immunity may be transmitted from parent to child. The new Therapeutic method is based on established facts that animals, susceptible to disease, and protected in the highest degree of freedom, from infection with pathogenetic bacteria, or with their chemical products, are competent to provide a serum which, introduced into the system of other susceptible individuals, will afford them defence against similar infections.

From these considerations a spacious and hopeful future appears to be dawning for the removal or distinct reduction of the morbid effects of certain seriously destructive diseases. And, hence, the future prolongation of life on the average, so far as these pathogenic agents of disease are concerned, seems to be a definite possibility, especially when we combine the correlative coexistence of an enhanced condition of immunity being capable of transmission to the descendants of those who have been enabled to attain an acquired power of resistance, when they did not possess a natural capacity of that character.

We observe the twofold power arrayed against these invading organisms; the discovered resisting power inherent in certain tissues and fluids, and the resources of medical science in cultivating an artificial protection where the natural resistant or refractory force is feeble or practically absent.

Natural immunity has always existed, being a constituent condition of the system; but it is obvious that the definite recognition of its situation and range brings within the domain of medicine the

practicability of devising methods and appliances for its special cultivation and the augmentation of its vigour.

In connexion with the subject of Natural immunity, I may be permitted to devote a brief space to a description of the hypothesis of Phagocytosis* propounded by the Russian physiologist, Metschnikoff, on account of its impressive and marvellous revelations. This hypothesis in principle is still admitted to an integral place in the explanation of the general subject, though, in consequence of the evidence that the animal body is inherently endowed with superior means of resistance independent of Phagocytosis, it does not now possess the pre-eminent position which, at its original announcement, it startlingly occupied. The picture is profoundly interesting in its exhibition of the internecine warfare which, independent of the intervention of the human Will, is perpetually proceeding within the system in infective processes, while the patient is conscious in no degree of the internal struggle, but acts simply as the objective register of the fluctuations of the combat displayed in the symptoms of the disease and the alternations of improvement or retrogression of health as victory inclines to friend or foe. A destructive micro-organism finds ingress from without ;† instantly, certain cells, present in the blood and in some of the other fluids which bathe the tissues, including the white corpuscles of the blood,—(whose function had been previously unknown),—swarm through the vessel-membranes, and attack the intruders ; these cells collectively are termed leucocytes, or white cells ;‡ they possess a proper motion of their own, and act as the scavengers of the blood ; these cells envelope the bacteria within their bodies for destruction, while the foes reply by emitting their lethal poisonous products. If the fight terminates in the defeat of the leucocytes, death ensues ; if, on the contrary, the bacteria are destroyed by the superior vitality of the cells, recovery to health will result. Now whether the particular form of this hypothesis should remain

* φάγειν, to eat : κύτος, a cell.

† P. F. Frankland : *Our Secret Friends and Foes* : chap. vi.

H. W. Conn : *Bacteria* : chap. v.

A. R. Wallace : *The Wonderful Century* : chap. xiv.

‡ λευκός, white : κύτος, a cell.

unrivalled or not by wider and more minute investigation, it appears evident, from the whole range of physiological discovery, that some analogous process occurs in infectious disorders; that some of the tissues possess this inherent aboriginal endowment of recognising (to employ a term without, of course, its customary *detail* of meaning) and resisting external agents of disease; and the researches of physiology, in its pathological aspects, are certain to advance successively and successfully in aiding the duration of life (and consequently, the increased probability of Centenarian examples, with the larger attendant prospect of deciphering their order and cause*), by (i) assisting, in appropriate supplemental modes, the native activity and vigour of these germicidal agencies already existent in the system; (ii) strengthening and developing them further by artificial means of inoculation; and (iii), by a more extensive and intimate study of the nature and history of the pathogenic organisms themselves, devising the expedient machinery for cancelling or reducing their disintegrating efficiency if they chance to effect an entrance, or counteracting the possibility, in an expanding number of instances, of an ingress altogether within the body.

VIII.—THE FORMULA OF THE CONSERVATION OF FORCE.

The universal formulæ of the Conservation of Force and the Indestructibility of Matter, apply to the human mechanism.† Whether we regard the body as an electro-magnetic machine, in Helmholtz's analogy, or trace its resemblance to any other scheme of machinery for conversion of Force from physical mode to mode, the fact of imperishability remains,—not as a coherent organism, for disintegration must ensue, but as a system of ultimate particles, severed, from their existing particular forms of conjunction, at that epoch. And the stable effectiveness of the union and the organic continuance of its parts, with the sustained exercise of their interrelated functions, depend partly on the original and inherited structure, and materially upon the successive, correlated adjustments of its form and

* Page 103.

† H. von Helmholtz: On the Application of the Law of the Conservation of Force to Organic Nature. [*Proceedings of the Royal Institution of Great Britain, 1861.*]

energy to the varying conditions of the ever-changeful environment. But, unhappily, a general truth of this character, though an integral factor of the question, fails us, in the present state of our knowledge, in the solution of the problem. Sit Lux !

IX.—THE AGE-RELATIONSHIP OF THE HUMAN RACE, THE EARTH, AND THE SUN.

The essential physical connexion between the continuance of the Human Race, the vitalising capacity of the Earth, and the maintenance of Solar Energy, affords a profound and deeply instructive subject of contemplation. The Material Structure of Man, and the consequent exhibition and exercise, under existing phenomenal conditions, of his spiritual intelligence, are dependent upon the sustained activity of the Globe he inhabits, while that sphere is indissolubly linked with the secular destinies of the Sun. Upon the former proposition it is the less needful to dilate, seeing that the latter problem involves the necessary criteria. The entire question accordingly resolves itself ultimately into the approximate definition of the stage in evolutionary Time-development of the Solar Centre of Life. I append a few of the probable conclusions of Science upon the three factors.

(i.) MAN.

Accepting the doctrine that Man presents the noble ascent from an ancestor whom Darwin* described as "arboreal" in his habits, Mr. A. R. Wallace† has surmised that Man probably diverged from the common ancestral form in even the Miocene stage of the Tertiary period, and then first assumed the true type of the Species,—the *homo sapiens*. At all events, a minimum limit to the date of his earliest appearance may be assessed at 100,000 years ago‡; it may possibly be 250,000 years§; in place of the 4004 years prior to the Christian era, assigned by Archbishop Usher. I need not enlarge upon the discrepant views of Darwin and Wallace respecting the origin of his

* The Descent of Man : Part i., chap. vi.

† Darwinism : chap. xv.

‡ W. Durham : Evolution.

§ S. Laing : Human Origins : chap. ix.

E. Haeckel : The Last Link : Our Present Knowledge of the Descent of Man : Geological Time and Evolution.

higher faculties; and I would simply add that I have myself long entertained the conviction, which accords essentially with the judgment of Wallace, that, when the physical organism had practically attained its competent form, the "*divinæ auræ particularis*,"—the equipment in rudimentary shape of the loftier and expansive æsthetic, intellectual, and moral susceptibilities,—supernaturally supervened, as poetically but adequately phrased by that wonderful seer, the unknown author of the 7th verse of the 2nd chapter of Genesis.

It is obviously difficult to indicate the stage in natural evolution at which the Race has arrived: it might be alleged, for example, that the culmination of physical progress has not yet been reached; that the eye, for instance, from its present differentiated localisation on the enclosing membrane, (specialised from an originally uniform sensitiveness to external stimuli), has not received its completed finish of workmanship, for Helmholtz* has pointed out, (after describing the imperfections of that organ in respect of achromatism and spherical aberration), that "if an optician wanted to sell me an instrument " which had all these defects, I should think myself quite justified in " blaming his carelessness in the strongest terms and giving him back " his instrument." But, on the other hand, spectacles, microscopes, and telescopes, (founded, as they are, on the analogy of the eye, and the phenomena of vision), may also possibly indicate a decline from *former* acuteness and range, and obviate, by their persistent use, any future natural development in the capacity of the organ itself. The period of evolution of the eye, therefore, would probably appear to be terminated, both as a feature in the history of evolution, and also as a consequence of man's own supplemental mechanical action.

And the considerations adduced by Whewell† tend to show that the chapter of Man's general physical development may be regarded as practically closed; while mental expansion has hardly advanced with the concurrent progress of knowledge and of its co-ordinations and generalisations which have been achieved. The future, therefore, so far as evolution is concerned, may perhaps be essentially conjectured to be limited to the arena of moral and spiritual enlargement.

* The Recent Progress of the Theory of Vision.

† The Plurality of Worlds: chap. xiii.

The Race is dependent directly upon the resourcefulness of the Earth for food; for fuel; for the provision of the materials for mechanical and industrial improvement, and the scale of commercial exchange: directly also upon the Solar energy for the prime motors of heat and light; and ultimately upon the same primeval source for even the immediate contributions of the Earth to the continuance of human advance, which exhibit mere transformations, in varied forms, of an aboriginal power derived, in its origin, from the Sun through the intervening mechanism of terrestrial capacities and activities. Man's possible duration as a Race is thus involved in that of the Earth as a scene of energy, and the Earth again is simply a humble dependant upon the sustaining functions and bounties of the Sun.

(ii.) THE EARTH.

In the Nebular Hypothesis of Laplace,* the Earth's formation is subsequent to that of the Sun. The Sun originally existed alone, surrounded by an atmosphere which, by virtue of its excessive heat, extended far beyond the present orbits of the planets. As the nebulous and rotating mass diminished, and the solar atmosphere contracted by cooling, the rapidity of its axial revolution increased, in accordance with the laws of rotatory motion, and exterior zones of luminous vapour were successively detached in consequence of the centrifugal force overbalancing the force that tended to the centre. These rings of vapour, (except in the unique instance of Saturn), would be disrupted into discrete masses, and then, under the power of gravitation, would coalesce into independent bodies retaining their original form of revolution round the central solar aggregate from which they had been severed. These sundered fragments constitute the Earth and Planets, deriving their origin, equally with their supplies of force, from this primeval reservoir.†

* The System of the World: Vol. ii., Book v., chap. vi.

† With his customary scientific accuracy, Tennyson has depicted the scene in "The Princess," though extending his survey over a wider cosmical space:

" This World was once a fluid haze of light,
 " Till toward the Centre set the starry tides
 " And eddied into suns that, wheeling, cast
 " The Planets."

Although the energy received by the Earth is but the $\frac{1}{2,000,000,000}$ th part of the aggregate radiant energy which the Sun scatters annually into space, yet this minute fragment, expressed in light and heat, (or, generically, in terms of the modern doctrine, expressed in molecular motion), is adequate to provide and sustain the multiform activities on which the Race depends. Dr. H. R. Mill* furnishes the following illustration: if the Sun were expending money in place of mechanical power at the rate of £18,000,000,000 a year, the Earth's share of his benefactions would be represented by £9.

The terrestrial forms of energy available to man for the production of mechanical work, and the continuance of his existence, are almost completely of a potential nature,† and comprise Fuel; the Food of Animals; Ordinary Water Power; and Tidal Water Power; while the Kinetic forms consist of Winds; Ocean Currents; Hot Springs; and Volcanoes. The immediate sources of these supplies embrace the Primordial Force of Chemical Affinity; the Earth's rotation about its axis; the Earth's internal heat; and, essentially, Solar radiation. Fuel is simply due to this radiation; Coal is the result of transformation, in vegetable cells, of Solar energy into the potential energy of Chemical affinity; Food, again, is vegetable, or animal (and therefore ultimately vegetable), and dependent, consequently, upon Solar diffusion, as Herschel long ago observed. Ordinary Water Power is produced by evaporation, and embodies the effects of radiation from the Sun. Tidal water power also,—prophetic, through mechanical appliances, of enlarging capacity in man's service,—is derived from the energy of the Earth's rotation, which tends to expand the length of the terrestrial day, and concurrently to diminish the store of the Earth's vital resources, by reason of the Tidal friction of Revolution,‡ and the consequent dissipation into space of useful force in the shape of irrecoverable heat; while Winds and Sea Currents, on which navigation and the working of machinery depend, are simple conversions of force emitted from the Sun. Hence the entire compass of

* The Realm of Nature: chap. v.

† P. G. Tait: A Sketch of Thermodynamics: Art. 144.

‡ G. H. Darwin: The Tides, and Kindred Phenomena in the Solar System: chap. xvi.
Sir Robert Ball: Time and Tide: chap. i.

the Earth's contribution to the maintenance of the Race is essentially implicated in the duration of Solar Power. No augmentation of a particular form of energy, thus available to man, can be produced, according to the Principle of the Conservation of Force, without a simultaneous diminution of some other pre-existing mode. Nature, to adopt a personification, presides at the Receipt of Custom of the Universe, and distributes her gifts, but each gift is the precise commercial exchange for an equivalent donation from man to herself. If man requires energy in the shape of heat, he must present Nature with Joule's mechanical equivalent of 772 foot-pounds of work *; if, for any specific purpose in view, he demands his energy in a concentrated and compact form,—a sterling pound of power,—he must strictly and exactly offer, in barter, twenty separate shillings of more diffused modes of force. "Do ut des" is the motto engraven upon Nature's signboard as the condition of her commerce. Man may voluntarily, again, alter in a degree the existent composition of the Universe; by a volition of the mind to turn the handle of a frictional electric machine, he may vary the comparative constitution of the forces which surround him; his will, acting through the medium of his nervous and muscular mechanism, may excite his arm to labour; and the result will be that a definite portion of Solar energy, embodied in the muscular system through the energy of food (ultimately obtained from the radiation of the Sun), is converted into the shape of electricity through the directing agency of the machine; but this sequent redistribution of the various classes of energy in no degree augments or reduces the total quantity of force existent previously in the Universe. Moreover, every conversion of energy into useful work is accompanied by the elimination of heat, which is scattered into space, and thus permanently extinguished as serviceable to the needs and operations of man. No natural process is precisely reversible. Mechanical power can be readily and completely exchanged into heat, but no known material process can reconcentrate the whole of an assigned thermal supply into helpful forms of work. In the most economically-constructed engines for the transformation of force,

* The dynamical equivalent of heat, that is, of the heat required to raise the temperature of 1lb. of water by 1°F., is represented by the work effected by the fall of 772lbs. of matter through the space of 1 foot, and somewhat varies, of course, with the latitude.

75 per cent. of the heat produced is inevitably wasted and lost. The extraction of coal (the condensation of Solar radiation) is proceeding at an appalling rate ; and the present annual supply from Great Britain and the United States alone amounts to upwards of 382 million tons.* When we reflect,—not merely on this enormous abstraction from the Earth's resources of activity, but especially,—upon the proportion of the energy embodied in coal, which, through combustion for various purposes, escapes into stellar space without the remotest prospect of recovery for man's continued requirements, we are confronted with another perilous and accumulating diminution of the possibilities of human duration. Though the reference may at first sight appear to be trivial, it may be noted that, however excellent, as it undoubtedly is, from a sanitarian aspect, the revived method of Cremation adds a further mode of hopeless dissipation of energy in the form of heat. It has been calculated that the Earth is being deprived of Energy, by the abstraction of its heat, at the rate of 112×10^{18} (or 112,000,000,000,000,000) metre-tons of material power each year. (The metre-ton, or the mechanical equivalent of the squandered heat, indicates the amount of work required to overcome, through the space of one metre,—about $3\frac{1}{4}$ feet,—a force equal to the weight of one French ton,—about $\cdot 98$ of a British ton,—at the Earth's surface). As Dr. Croll then finally expresses it, the history of our Globe is limited by the age of the Sun's heat.

(iii.) THE SUN.

We are thus restricted, finally and exclusively, to the conditions affecting the duration of the Sun itself, as the source and fount of power, on which the persistent rhythm of terrestrial activities depends, and the involved maintenance of the Human Race.

According to the Gravitation Theory of the distinguished physicist and mathematician, H. von Helmholtz,† the initial form

* W. S. Jevons : The Coal Question.

The Right Hon. L. H. Courtney : Jevons's Coal Question : Thirty Years After.

[The latest Mineral Statistics published by our Home Office show that the annual output of Coal throughout the world now amounts to upwards of 582 million tons !]

† On the Origin of the Planetary System.

of Energy in the Universe was the potential energy of gravitation in matter irregularly diffused throughout infinite space. Assuming that the matter now constituting the Solar System had primarily extended over a sphere encircling the orbit of Jupiter, the falling together of the several parts into the discrete aggregates, now presented by the Sun and Planets, would account, by the stress of collision, for the whole amount of Energy they now possess in the forms of heat and of orbital and axial revolution. Had the mass of the Sun originally been diffused in cosmical space, and had then become condensed,—that is, had fallen together under the influence of universal gravity,—and the resultant motion then been destroyed by friction and impact, with the evolution of heat, (the precise equivalent, according to Joule's Law, of the motion extinguished in the coalition), the orb or sun, generated by this condensation, must have acquired a store of energy, in a thermal mode, of colossal magnitude. In discussing this subject, Dr. J. Croll,* while accepting Helmholtz's Theory, remarks that it assumes the matter composing the Sun to have primally possessed no temperature, while existent in space as a diffused nebula, and that the temperature was generated as the mass became condensed under the force of gravitation; in other words, that the whole of the resulting heat consisted of the heat of condensation. He accordingly suggests the conceivable hypothesis that the vaporous substance might itself have been initially endowed with an aboriginal store of heat prior to condensation; indeed, he adds, the very reason of its existence in so rarefied and gaseous a condition resided in its excessive temperature—(thus introducing, it will be observed, an essential element of Laplace's hypothesis),—so that the occurrence of condensation only commenced when the mass had begun to cool. Calculating that two bodies, each containing one-half the weight of the present Sun, and moving directly towards each other with a velocity of 476 miles per second, would, by their concussion, produce, in a *single moment*, 50 million years' supply of the Sun's existing heat-expenditure, he enquires why it may not be surmised that the Sun was originally composed of two such bodies, and his primitive thermal store have entirely

* Climate and Time : chap. xxi.

resulted from their collision. In addition to this primary fund of temperature, Lord Kelvin* has remarked that a portion of heat is produced in the Sun's atmosphere by the influx of meteoric matter from external space, attracted by his mighty gravitating power, which aids the maintenance of his radiant energy ; while, on the other hand, it is very probable that the annual radiation is not sensibly compensated by a continuance of meteoric action. He, therefore, is inclined, on the whole, to consider that Solar emission is not counter-balanced to any appreciable degree by any accession of heat provided by impinging meteors, so that the Sun is probably an incandescent liquid mass in continuous process of cooling.

The Solar temperature is maintained, at the expense of his dimensions, by this incessant shrinkage of his mass from cooling in consequence of the mechanical work effected (and its transformation into heat-energy) by the mutual gravitation of all portions of the diminishing volume. The force of the gravitational energy of shrinkage, to which the Sun's activity is almost entirely due, is important ; for the work performed in any assigned period of time by mutual gravitation of all the parts of the fluid, as it is reduced in size by reason of the diminution of its temperature, is practically equal to the dynamical equivalent of the heat which the Sun emits in precisely the same time. The rate of shrinkage corresponding to the existing rate of Solar radiation amounts to the $\frac{1}{10,000}$ th part of the radius of the sphere during each 2000 years. Hence, the Sun's radius must have been larger by one per cent., 200,000 years ago, than it is at present. So that, 5 or 10 million years ago, the Sun may have possessed a diameter of double its present extent.

Professor S. Newcomb,† arguing from the annual amount of emission and its mechanical equivalent, considers that the Sun is diminished by 4 miles within a century.

And, reverting to Croll's numerical illustration, I may mention that, taking two solid cool globes, each of the mean density of the Earth and of one-half the Sun's diameter, and assuming them to be

* On the Age of the Sun's Heat : Part i., ii., and iii.
On the Sun's Heat.

† Astronomy : Part iv. : chap. iii. : The Cosmogony.

initially at rest at a distance of twice the Earth's distance from the Sun; then starting them in motion, they would come into collision, Lord Kelvin calculates, in half-a-year; the concussion would endure for half-an-hour; and each would be transformed into an agitated incandescent fluid mass extending to a considerable distance from the line of motion pursued prior to impact. The nebulous volume in the course of two or three years would centrally condense, and become compressed into a globular orb of the same mass, heat, and brightness of the present Sun.

It appears evident, then, that whether created originally as an active source of heat, at a period not immeasurably remote, by a Divine decree, or whether the stores of energy, partly radiated in the past and partly still possessed, were acquired by a natural process observing established laws—(the latter hypothesis being the more probable since it is not contradictory to discovered modes of action and ascertained physical uniformities and analogies),—the Sun is *not* a burning fire, but simply a white-hot incandescent fluid in a continuous condition of progressive cooling, with an inappreciable accession of contributory energy from the impact of occasional meteoric matter. It is probable that the rate of cooling of the Sun is in excess of a fraction over 1°C per annum, so that his mean temperature is reduced about 100°C between 700 and 700,000 years. The estimate has been made by Lord Kelvin that the annual emission of radiant energy from the entire surface of the Sun amounts to 6×10^{30} (or 6 million million million million) times as much heat as would suffice to increase the temperature of 1lb. of water by 1°C . It may be further observed that the maintenance of the present rate of radiation of Solar heat would require, for example, the combustion of 1,500lbs. of coal per *hour* on every square *foot* of the Sun's surface, which exceeds 2,284,627 square *miles*; and were the Sun entirely composed of coal, the complete mass would be consumed in 5,000 years.

The question then arises as to the probable duration of future effective Solar emission; and, conjoined with the estimated expenditure in the past, the approximate stage of evolution, in respect of competent energy, at which the Sun, and consequently the Earth, and therefore the Human Race, has arrived.

Lord Kelvin estimates that it is most probable that we cannot for the future rely upon a larger Solar radiation than 20 million times the amount of its present emission in a year.

Professor S. Newcomb* argues that the calorific product of Solar contraction (assuming no extrinsic sources of supply) could have yielded the existing rate of radiation for 18 million years of past experience, and that it may be confidently anticipated that the Sun cannot afford sufficient heat for the support of terrestrial life, the form of life with which we are acquainted, for more than 10 million years from the present date. So that the completed duration of the Solar System may be regarded as compressed within an æonian period of about 30 million years.

Dr. Croll considers that the *entire* geological history of the Earth must have been comprised within less than 100 million years.

Helmholtz expressed the view that the heat which the Sun could have developed by the condensation of his mass would have proved adequate to provide its present expenditure for 22 million years in the past, and that it might be assumed for the future that the same intensity of sunshine as that now constituting the source of all terrestrial activity might proceed for 17 million years to come. He proved that a contraction in the Sun's diameter of 250 feet per annum (or four miles in a century),—a diminution so slow as to be quite imperceptible to observation,—would generate his entire yearly heat-expenditure.

Lord Kelvin, again, deems it exceedingly rash to assume more than 20 million years of sunlight in the past history of the Earth, or to reckon on more than 5 or 6 million years of sunlight for the future. And, of course, it must be noted that, concurrently with the *progressive* diminution, the time must arrive, *prior* to total extinction, when the remaining energy will be insufficient to maintain man's vital vigour in its existing capacity, so that *accelerating* decrepitude will ensue in an *increasing* ratio. Professor P. G. Tait† has stated that a period of

* Dr. C. A. Young: *The Sun*: chap. viii.

Newcomb: *Astronomy*: Part iv.: chap. iii.: *The Cosmogony*.

† *Some Recent Advances in Physical Science*: chap. vii.

10 million years is the utmost that can be allotted for the *entire* history of even the lowest orders of geological fossils, and, from the physical point of view, for the occurrence of the whole range of changes which have prevailed upon the Earth's surface since vegetable organisms of the earliest known forms were capable of existence upon our Globe.

In the expression of the finished Theory of Force,—its established Conservation and Transformation,—Lord Kelvin* added the completing Element of Dissipation ; and this proposition forms one of the most impressive evidences of his wonderfully penetrative insight into the intimate processes of Nature. There exists a predominant declension in the Universe to the conversion of energy into the uniform condition of heat, and its equal diffusion by radiation throughout space. The production of mechanical power postulates a material system in which various masses exist at different temperatures, so that, in consequence of this invariable and incessant tendency in Nature all bodies in the Cosmos are proceeding to an ultimate state in which an undifferentiated uniformity of heat will be established, when all motion in the Universe will terminate, and permanent rest and death will ensue.

We possess, again, no adequate reason to believe that the orbit of the Earth about the Sun is absolutely stable. It appears to be scientifically natural to suppose,—notwithstanding the demolition by Professor Tait of the suggestion that the movement of Encke's comet was retarded by a resisting material medium,—that some matter in a diffused condition exists in planetary space, operating in accumulative force in diminishing the Earth's extent of circuit, so that, in the language of Professor W. K. Clifford,† “all we know is that the Sun “is going out : if we fall into the Sun, we shall be fried ; if we go away “from the Sun, or the Sun goes out, then we shall be frozen. . . . one “of these two things must take place in time.” In the words of Professor Helmholtz, the Earth must either be frigidly solidified in time or united in heat with the Sun. Hence the cessation of life on the Earth may occur long prior to that stage of diminution of Solar Energy which may constitute the limit of maintenance of human

* On a Universal Tendency in Nature to the Dissipation of Mechanical Energy.

† The First and Last Catastrophe.

activity, just as the origin of life succeeded to unnumbered æons of previous cosmical time.

The preceding considerations are of course based upon the assumption that the Solar Universe is a closed System receiving no supplies of energy from external sources. It is interesting in this aspect to adduce a most ingenious speculation of Professor W. J. M. Rankine,* which is the more instructive since it involves an exact conformity with existing processes and laws disclosed in Nature. When the epoch has arrived at which the general Dissipation of Force has effected its completed result, and all spheres and bodies are devoid of energy by reason of the uniformly diffused condition of equal heat, Rankine (postulating the genuinely scientific conception that the ethereal medium may possess an enclosing boundary beyond which only empty space exists) suggested that, as the heat-undulations reached this barrier, they would be totally reflected, according to the Theory of Undulations, and become reconcentrated in foci situated in different portions of the circumscribed area ; whenever, then, a cold and extinct star happened to proceed through one of these foci, ignition would instantaneously occur, and the globe resolved, by the intense heat, into its constituent elements ; discontinuity accordingly would ensue in the history of that orb, which would recommence its evolution afresh with the renewed supply of energy thus obtained.

(iv.) CONCLUSION.

The Earth as a material fund of Energy for Man is thus incessantly reduced in vital sustaining power by the conjoint process of thermal abstraction with diminished Solar supply ; and these considerations, though only acceptable within certain limits, appear reasonably to suggest that the Solar System, and consequently the Human Race, have attained their *practical maturity or midway stage*, at the present period, and may be expected to exhibit the evidences of decline. I am here directing attention to the indications of the preceding numerical statements with respect to the critical *epoch*, in the vast chronological development, at which the Material Universe may be approximately assumed to have now arrived.

* On the Reconcentration of the Mechanical Energy of the Universe (*The Philosophical Magazine* for 1852).

The significance of the estimates I have cited, with the consistent unanimity they display, essentially resides, let me repeat,—and this is the teaching I desire to enforce,—in the general assignment of the present age as the *meridian* of the life-supporting vigour of the Universe,—or, proximately, the *middle-point of its Entire Course*,—and, by involution, the associated *Maturity of the Race*. This profound indication with regard to the age-history of our Species is deepened and emphasised by the supplementary observations which I now proceed to discuss. Moreover, it should not fail to be distinctly remembered, as I have already remarked, that just as human life only became physically possible after countless æons of the ancestral evolution of the Globe and Universe had passed, so the termination of the Race may probably occur myriads of ages antecedent to the actual extinction, as sources of energy, of these material factors of its maintenance in existing forms and capacities.

An illuminative comparison is furnished,—and there seems to be valid ground for detecting and adopting the analogy,—by regarding in juxtaposition the successive eras of an individual life, with their intellectual implications as to maturity, and those appertaining to the Race. In the former, the sequent periods of growth, completion, and decrepitude can be readily grasped on account of their finite expression ; but although corresponding stages exist in the history of the Race itself, definiteness of conception and measurement is necessarily impracticable, and the years of the individual progress must be expanded vaguely into ages. But the succession of definite eras seems reasonably clear. Now in the development of the individual creative Intellect, the highest epoch of its power consists in the discovery and grasp of some culminating Generalisation of Nature within which are subsumed all the partial inductions collected and verified in the intellectual history of the past. This signal advance essentially occurs in the *maturity* of the individual's capacity, and forms an index of the zenith of his cultivated brain and mental vigour. And in the record of the Race, no loftier or more comprehensive generality has been attained than that of Newton's conception of the Force of Gravity and its uniform numerical expression, unifying, as it does, the entire assemblage of the scattered and apparently disconnected portions, molar and molecular, proximate and remote, of the

Universe within the bounds of a definite, pervasive Law. Another wide intellectual conception,—equally extensive in its scope and combining range,—that of the marvellous Ethereal Medium,—was concurrently comprised within the keen and serene comprehension and insight of Newton, for he describes this medium as “a most “subtle spirit . . . by the force and action of which the particles of “bodies mutually attract one another”*; and it is strikingly mentioned in his famous letter to Dr. Richard Bentley. Even,—to complete the Scientific Trilogy,—the grand dominant doctrine of the Conservation of Energy is shown by Professors Thomson and Tait† to possess its foundation in the scholium appended by Newton to his enunciation of the Third Law of Motion. In its most general form, remark Professors Tait and Balfour Stewart,‡ and J. V. Marmery,§ the proposition of the Conservation of Energy is merely a completed version of Newton’s second interpretation of that Law, which may at once be translated into the modern expression of the Doctrine. These fundamental cosmical conceptions of Science, present not merely the loftiest strain and altitude of Mind, but the vastest generality also attainable in Physics, and may be regarded therefore as affording a sign of the intellectual *maturity* of the Race. The subsequent imposing mass of contributory and accessory discoveries and physical truths has mainly exhibited the application of deductive processes, resting on these essential and regulating propositions, to the interpretation and co-ordination of other phenomena and causal relations of Nature.||

* The Mathematical Principles of Natural Philosophy: Book iii.: General Scholium.

† A Treatise on Natural Philosophy: Vol. i., Part i., § 268.

‡ The Unseen Universe: chap. iii.

§ The Progress of Science: chap. x.

|| It is needless to refer in detail to the luminous and massive Conspectus of Evolution depicted, by the hand of a Master, in Mr. Herbert Spencer’s “First Principles.” Without assessing the supreme value of that profound Treatise, with its explicit developments in the succeeding volumes of the System,—which it would be impertinent on my part to attempt,—I may briefly state that it proceeds, [with Von Bär’s Law of Development involved,] upon the basis of the doctrine of the Persistence and Conservation of Force, and rests, therefore, in its elements, upon Newton’s propositions, traced out in their consequences, with marvellous knowledge, grasp, and insight, into the multitudinous phenomena of the entire Universe. And Mr. C. Darwin’s memorable work of Research and combining Thought displays the application of the general Doctrine to the Origination of Species under guidance of the elucidatory principle of the Survival of the Fittest or Natural Selection.

Two names imperishably enshrined in the intellectual history of the World!

It is accordingly probable, employing the analogy of individual evolution and Racial development, in the intellectual sphere, that the Race has approximately attained its *mental limit*, or the culmination of its *meridian*, delegating to the future, so far as cardinal and basal truths are involved, the fruitful and ancillary application and extension merely of these pre-eminent inductions.

The remaining impressive problem of combined psychological and physical research is that of the conversion of molecular nervous undulations into the energy of spiritual thought. It is, however, unnecessary to discuss and appraise this question in relation to our subject of human matureness, for I share the view of Professor Tyndall* that not merely is the proposition insoluble,—the transition from physics to metaphysics,—in our present complex constitution, but that it transcends any conceivable extension, in the circumstances of our existing phenomenal being, of the powers we possess. A conjoint coexistence of the two factors, corporeal and psychical, which are incompetent of disjunction in the enquiry, prevents the possibility of solution, and the question accordingly seems to be analogous to the nature of the attempted investigation into the psychological structure of animals,† where the successful prosecution of research demands the impracticable postulates of a simultaneous endowment of the animal consciousness, and of the possession of the human consciousness for decipherment and recollection of the ascertained results.

Surveying generally the *average* intellectual condition of the present period, I should be inclined to surmise that it exhibited no sign whatever of ampler development. The extending dominion of Newspapers, Journals, Magazines, Light Literature, and Novels,—the era, it may be fittingly described, of disconnected and fragmentary paragraphs,—is subverting the faithful study of original Books, the cultivated habit of consecutive thought, and the growth of intellectual vigour and discipline. The memory is laden merely with individual and isolated facts, collected in scattered units without personal mental toil, the invigorating power of co-ordination, or the intellection and utilisation of unifying principles; the exercise of individual mental

* Heat : a Mode of Motion : Lect. xvii.

† H. L. Mansel : Metaphysics : Part i.

energy, the formation of intellectual concentration, and the moral discipline, won by arduous toil, with its vitalising influence upon the construction of Character, appear generally to be vanishing. Materials, unrelated and uncoordinated, are supplied in scanty sections, but no organised system of truth is diligently and painfully created, and any native power, through lack of personal effort, fails to spring from latency into enterprising life; knowledge has simply become a mechanic deposit, and has lost its capacity as the instrument of a generous self-cultivation; the active intellectual faculties decay from cessation of an orderly, strenuous, and responsible strain; the devotion of a fresh and original attention to questions of life and thought, and the deduction of conclusions which the reasoner can claim as the priceless reward of his own studious labours, seem definitely on the wane; while the general mental structure as a whole, in consequence of the inglorious and parasitic tendencies I have mentioned, is lapsing more and more completely under the dominion of the exclusive and unfruitful passive receptivity of memory,—unorganised and disjointed memory,—alone.

How feeble and puerile are the form and compass of ordinary general conversational intercourse at the present day! As Mr. Herbert Spencer* has justly pointed out, the intellectual character of a person may be conclusively inferred from the proportion in his utterances of personal and individual statements to the more general propositions and the wider terms he employs; the simple truths relating to units as compared with truths abstracted from numerous experiences of men and things. And an impartial speculator can hardly refuse to affirm, and to lament, that the ratio of the inferior to the nobler elements of thought and discussion is diminishing in our customary mental intercourse as an unhappy index and criterion of our more impoverished intellectual life. And since atrophy in Nature is the inevitable Nemesis of renounced responsibility of trust, it may be conjectured that, if this condition of mental torpidity and labourless and fragmentary acquisition be continued, the future intellectual vitality of the Race generally will persistently decrease.

The progress of Literature appears to reveal a similar form of

* The Study of Sociology : chap. ii.

evidence. I speak, of course, generally, for a few fine exceptions happily exist, which rather, however, attest a past than indicate a future. Adopting the poet Wordsworth's instructive distinction, I refer to the Literature of Power, the Literature of Creative Force, as contrasted with the Literature of Knowledge. We perceive, as a general observation, few worthy Formative Successors to the powerful and decisive creations of Shakespeare, Milton, and Dante. These tower, like solitary and stately monuments upon a desolate plain, pathetically marking and emphasising, by their loneliness, the dull and arid monotony of the wide expanse. Do they not suggest, in their unique impressiveness, the probability that, in this intellectual domain also, the meridian of the Race has been approximately approached? I would merely and significantly venture to add, as a laic, that, as displayed in our Paintings and Sculptures, the fineness of perceptiveness of Beauty of Form, its subtle and impressive rendering, and the profound Sense of Colour, are, it would appear, essentially claimed by the Past. The eye is still frequently delighted, the Taste sometimes discovers a recognised counterpart and incarnation, but the age of Masterpieces, the culminating embodiments of the highest reaches of harmonious natural insight with consummate technical skill, is largely now a regretful Reminiscence alone.

As a corporeal organism, again, Man appears to have reached his limit. The utilities of Civilisation, wonderful and admirable as they are, prove also hindrances in some degree to physical development. Her lavish profusion of material services towards the convenience and torpid ease of mankind tends to arrest the native activity and the power of expanding growth in readiness, refinement of action, and scope of vigorous exercise, which, otherwise, the more primitive and unsupplemented necessities of life would cultivate. The forces which, in the secular physical ascent of Man, have directed and invigorated the process of Evolution now seem to have spent their power. The keenness of scent is greatly reduced; the sensitiveness and capacity of the ear* have become lessened through the resources of civilised art rendering its delicacy and plasticity less vital to existence; I have

* C. Darwin : *The Descent of Man* : Part I. : chap. i.

E. Haeckel : *The Last Link* : Our Present Knowledge of the Descent of Man : Comparative Anatomy.

already referred to the mechanically and optically deficient condition of the eye, which is possibly interpretable in terms of declension ; the teeth are vanishing, largely through the modern neglect of vigorous mastication induced mainly by the comminuted form in which we take or divide our food ; while the profounder competition in the industrial and commercial struggle is entailing upon our successors an increasing burden of nervous exhaustion, and a diminished store of sustained capacity.*

The only mode in which enhanced energy appears to be manifested is that of commercial enterprise and strife. But this exhibition of the human intelligence is very far from its ennobling form ; and an extension of existence of this order affords little reasonable ground for anticipating an ampler and more rational and elevated progress. Although the consideration of the possible sustenance and augmentation of the moral qualities of Sympathy and Mutual Aid is involved in the contemplation of this aspect of human effort and struggle,—the resulting sorrows and reverses forming the occasion for evoking the finer emotional attributes into effective play,—the discussion of the subject would be somewhat irrelevant to the purposes of this Book, and must be merely suggested to the intelligent attention of the reader earnestly interested in the varying rhythm of the experiences and fortunes of the Human Race.

It is obvious that I am in no degree criticising the necessary and beneficent reign of Civilisation,—the essential mode of development of Man,—I am merely adducing certain accompanying circumstances pertinent to the question of the intellectual and physical maturity of Man, which attend its course, and seem to indicate its practical consummation at this punctual epoch. The nobler type and loftier expectation of Moral, and supremely of Spiritual, evolution, I submit to the student's thought, with the brief comment that this latter stage of progress, unfolding the "consummate flower" of human development, alone remains to be more painfully and exaltingly traversed, and involves no dependent connexion with a material environment and Universe.

* Drummond : *The Ascent of Man* : chap. iii.
E. Ray Lankester : *Degeneration*.

CHAPTER VI.

A RECORD OF VARIOUS SUGGESTIONS, PROPOSITIONS, AND
HYPOTHESES CONNECTED WITH LONGEVITY.

I proceed to mention some miscellaneous observations and deductions associated with the question, which, though, in many instances, devoid of validity or conclusiveness, present interesting and significant considerations for thought.

I.—THE RELATION OF THE PERIOD OF GROWTH TO THE
DURATION OF LIFE.

- i. The Comte de Buffon,* expressed the general doctrine that the duration of life may be in some manner computed from the time which is expended in the processes of growth. The plant or animal, he observed, which acquired maturity in a brief period, perished much sooner than one whose limit of structural completion was only attained at a later stage. Man's bodily frame is not fully unfolded until the age of 30; dogs reach their entire growth in the 2nd year; the man who consumes 30 years in development lives to the age of 90 or 100; while the dog, whose maturity is finished in two or three years, dies at the age of 10 or 12. A similar phenomenon, he added, is perceptible in the animal kingdom generally: large animals invariably survive longer than small ones, because they demand a more extended time before their growth is terminated. And, in another portion of his work, he implicitly fixes the ratio as 7 : 1, that is, the total duration is about 7 times the period occupied in growth. *Quod cito fit, cito perit.*

* Op. Cit.: Vol. iii.: Section v.: "Old Age and Death."

It is difficult to conjecture whether Buffon, in the selection of this proportion, was influenced by the mystic significance usually accorded to the number 7, as the expression of completeness. It is undoubtedly the fact that the ancient physicians were governed in their medical views by the doctrine of "Crises" or "Septennaries," in which it was supposed that all vital and pathological phenomena were regulated by this number. This system of Crises was apparently a deduction from the more primitive teaching that numbers possessed an inherent efficacy and meaning. One of the founders of Medicine, the Greek Physician, Galen, for example, is reported to have persisted in the belief of the virtue of 7 in the development of diseases. Theory affirmed that the patient ought to die on the 6th day; but death occurs on the 7th; this violation of the medical rule, however, is apparent only; it is not the technical system that is thus proved to be erroneous; it is the patient who is refractory, for his constitution has resisted the malady a day longer than it ought to have done according to the nature of things,—that admirable verbal refuge for inveterate ignorance. The Greek Hippocrates, the most celebrated physician of antiquity, also declared that some disorders only terminate on the 14th or 21st day,—multiples of 7.

- ii. The eminent Comparative Anatomist, Professor Richard Owen,* regarded this deduction as "an important physiological truth" or correlation, and remarked that later Physiologists,—more justly so described than Buffon, who was neither a Physiologist nor even an Anatomist in the present scientific significance of those terms,—have extended the basis of this vital element by noting the period at which the epiphyses of the long bones coalesce with the diaphysis, and, accordingly, they have suggested that the epoch of completed union of the epiphyses of the limb-bones with the shaft may indicate the natural term of life. I find, however, that Buffon had been anticipated in this view, for Dr. Thomas Burnet,† in 1680, expressed the judgment that growth in man lasted for a longer period in Antediluvian times, and thus "carried their

* *Fraser's Magazine* for February, 1872: "On Longevity."

† The Sacred Theory of the Earth.

bodies" to a greater height and bulk, for where the entire duration of life is more extended, the interval of growth is correspondingly prolonged.

- iii. M. P. Flourens* also treated of this interesting characteristic factor in animals from which the duration of life appropriate to the species may be inferred; and, while admitting that Buffon first based the duration of life on this physiological law,—the assignment of the period of growth as the index to totality of existence,—considered that the detection of this natural proportion formed the real physiological problem; and that Buffon failed to reach the truth by reason of his ignorance of the certain signs which indicate the term of growth. The sign, added Flourens, consisted of the osseous coalescence of the several portions of the bones. Observing a similar relation to be discernible in man and in the history of development of other animals, he arrived at the conclusion that the ratio was 5 : 1, or nearly so. Since, then, man grows for 20 years, he lives, according to the formula, for $5 \times 20 = 100$ years as his naturally appointed term; so that all vital phenomena in respect of duration of existence are united by the following chain of relations,—the duration of life is involved in the length of growth; the extent of growth is evidenced by the duration of gestation; while the term of gestation is based upon the height and size of the animal. Thus—

ELEMENT.	RABBIT.	MAN.	ELEPHANT.
i. Period of Gestation	30 days.	9 months.	about 2 years.
ii. Time of growth : (union of the epiphyses) ...	12 months.	20 years.	?
iii. Duration of life ...	8 years.	90 to 100 years.	200 years : (according to Aristotle and Buffon).

* Op. Cit. on Human Longevity and the Amount of Life upon the Globe.

The horse, again, grows for 5 years, and accordingly lives for $5 \times 5 = 25$ years.

- iv. Professor E. Ray Lankester* comments that the numerical rule furnished by Flourens would be a valuable one were it possessed of any foundation in Nature. But the facts adduced by Flourens, in addition to their scantiness and inferior degree of credibility, do not support the deduction of an exact quintuple ratio. His suggestion, however, of assigning the limit of the period of growth to the junction of the osseous epiphyses constitutes a proposition of practical importance.
- v. Hufeland† decides, from his own observations, that the accurate proportion is 8 : 1.
- vi. Professor J. G. McKendrick‡ observes that the speedier an organism attains maturity, the sooner occurs the reproductive capacity,—constituting the culminating epoch, and involving the highest degree of vitality, with the largest expenditure of energy,—and the more rapidly does the natural termination of life approach. The Professor assigns the period of maturity in man to the age of 20, and expresses the judgment that, in all animals, the stage of maturity is about one-fifth of the complete duration of life.
- vii. I may add that A. Weismann,§ the Biologist, has advanced the proposition, as the conclusion of his lengthened researches upon the Continuity of Germ-plasma, that a general correlation exists between the entire lifetime of individuals composing any given species, and the age at which they reach maturity in first proving capable of propagation.
- viii. For the sake of intelligibility, I may explain that all bones are composed of three parts : the shaft, or diaphysis, and two small quasi-globular masses of cartilage, one at each end, which are termed the epiphyses. During the interval of

* On Comparative Longevity in Man and the Lower Animals.

† Op. Cit. : chap. vi.

‡ Encyclopædia Britannica : s. v. Longevity.

§ An Examination of Weismannism : by G. J. Romanes : chap. i.

growth, each epiphysis is attached to the shaft by a loose cartilage ; and when maturity has arrived,—and as an index of such completion,—each epiphysis becomes rigidly consolidated with the shaft, so that the three portions now constitute a single solid bone. The diaphysis and epiphyses being originally of cartilaginous structure, ossification commences, in each part, from a central point and extends outwards until the entire mass has become ossified and solid.

II. THE DEPENDENCE OF THE DURATION OF LIFE UPON EXTERNAL PHYSICAL CONDITIONS.

The question has been frequently discussed whether varieties of climate, differences of individual and social habits and customs, the varying peculiarities of National or Racial constitution, and the nature or quality of particular foods, exercise an influence upon the longevity of man. .

- i. Buffon* has no hesitation in affirming that these elements possess no effect upon the period of existence, which, he states, is precisely the same in every country and in every age, presenting no differences in the European, the Negro, and the Chinese ; the civilised or the savage ; the rich or the poor. Any minute distinction which may be remarked in the term of human life seems to be dependent solely upon the quality of the air, since we observe an increased number of aged people in highly situated countries than in lower ones. And he points out that Jenkins and Parr, and many other long-lived individuals, pursued no peculiar arts for the preservation of their bodies ; they appear to have been peasants and labourers, accustomed to moderate fare and comparatively hard conditions of existence. Viewing mankind in general, life universally tends to 90 or 100 years.
- ii. In these observations of Buffon, Flourens agrees, and accepts the doctrine that the duration of life does not depend upon any external factors, but simply upon the internal constitution and the intrinsic virtue of the physical organs.

* Op. Cit. : Vol. iii. : Section v. : Old Age and Death.

- iii. J. L. A. De Quatrefages,* the eminent Naturalist, also propounded the same view that the duration of life is almost universally uniform in extent among all Races placed amid conditions of existence which are *relatively* equally favourable.
- iv. It will be observed how entirely this teaching is contradicted by the advance of physiological and physical knowledge where the all-paramount influences of the environment and the bacillar origin of disease (in shortening life) have assumed a most important function in determining the extent of life.
- v. The physiologist, Haller, thus sums up the conditions of long life, in his section on "Vitæ Genus": "Etiam Parre et " plerique qui longæ vitæ eminuerunt rustici fuerunt quorum " ingenia absque temerariâ suspitione putes mediocria fuisse. " Hæc ita interpretor ut curas nimias credam venenorum " esse pessimum ; et moderata gaudia propiora apathiæ et " spei confinia vitam alere persuadeam."
- vi. In his Contribution to the Transactions of the Royal Society in 1825, which I have cited on page 70, Mr. B. Gompertz stated that, in his investigation into Mortality statistics as exhibited in various Tables, he had observed a law which expressed, at successive ages, the numbers living, out of a certain assigned number at the commencement of the series, for equal intervals of long periods ; and pointed out that the law of geometrical progression approximately prevailed in large sections of different Tables of Mortality, during which portions, the number of persons existing at a succession of ages in arithmetical progression closely presented a series in geometrical progression. He then (Article 4) suggested the notion that death may possibly be the consequence of two generally coexisting causes ;—one the result of chance, without involving a personal disposition to death or deterioration ; while the other consisted of an increased inability to avoid destruction. If, for example, the old and young were equally liable to certain diseases, which should prove uniformly noxious to them both, it is evident that the deaths in each

* The Human Species: Book ix.: chap. xxxi.

class from those diseases would be exactly in the proportion of the number of the young to the old, provided an adequate mass were observed in order to enable chance to have ample scope for the display of all combinations of occurrence; the reciprocal intensity of mortality might then be stated to be constant; and did no other diseases prevail, except these, life at all ages would possess an equal value, and the numbers living and dying from a certain aggregate existing at a specified earlier age would decrease in geometrical progression as the age increased by equal additions of time. If, on the other hand, mankind be continually gaining seeds of indisposition, that is, an augmented liability to death (which appears to be a feasible supposition during a large section of life), it would follow that the number living, out of an assigned multitude of persons at a given age, at equal successive increments of time, would diminish in a higher ratio than that of a geometrical progression. And, in Article 5, he continues that, if the average exhaustions of a man's power to avoid death were of such a nature that, at the end of equal infinitely small intervals of time, he lost equal proportions of the remaining capacity to oppose destruction which he possessed at the commencement of those intervals, then, at age x , his ability to resist death, or the intensity of the mortality operating upon him, might be denoted by the analytical expression, aq^x , where a and q are constant quantities, obtained from the Table of Observations; and, consequently, the number living at age x (*i.e.*, x years from the origin), or L_x , would be furnished by the superposed exponential dg^{qx} .* As the rate of mortality is a continuous

* *Note*: If the capacity to resist death follow this hypothetical progression, *i.e.*, if it be diminished by equal proportions in equal periods of time, it may be expressed by a function of the form aq^x , where a is the value it possessed at the commencing age from which the x years are reckoned, while q is a constant depending on the rate of increase of intensity of the opposite factor, the mortality. It follows that the force of mortality, which is inversely proportional to the antagonistic capacity, exhibits a similar but reciprocal mathematical functional form. And applying this function, by means of the Calculus (involving the infinitesimal period of time, dx), we obtain, as the expression for the Number living at any age x , the resulting equation arrived at by Gompertz; where d is the constant quantity introduced by Integration; g , the number whose common logarithm is c ; and aq^x , the common logarithm of $\frac{L_x}{d}$.

function, Mr. Gompertz properly applies the principles of the Differential Calculus. This investigation is deserving of serious regard, as proceeding on a valuable assumption or provisional hypothesis, notwithstanding the fact that the proposition forms in no sense a deduction from accepted physiological data.

- vii. We might be conducted to the stage immediately prior to the precise analytical expression adopted, by simple considerations and by noting the progression of the numbers in a Table of Mortality, and then assigning, after repeated trial, a certain mathematical form to the conclusion of our observations. For it is obvious (i.) that man's capacity to maintain life diminishes with age, until it reaches zero, and life vanishes: the reduction of the power to oppose destruction is merely the statement of the fact that man grows feebler: it is evident further (ii.) that the proposition that man's resisting ability abates is equivalent to the affirmation that the power of death increases, or, as Mr. Gompertz phrases it, the intensity of mortality. Seeing, then (iii), that natural capacity is a reducing quantity, the question arises whether the series of its diminutions exhibits any uniformity of progression: a uniformity, of course, which reciprocally will apply to the opposed and correlative intensity. Many assumptions (iv.) may be adopted,—tentatively embodying such a uniformity, and no expression is objectionable provided it be verified by comparison of its deduced consequences with actual observations. It is clear (v.) that, in respect of the quantity of natural and successive exhaustions, we may find it proceed either in *portions* or *proportions*, or a combination of the two, since these contain the whole of the possibilities: the portions or proportions, again, may either be equal or unequal or cyclical or intermittent; while the intervals of time, in which the sequent effects are produced, may be equal or unequal; so that we may possibly discover equal portions in equal times, or unequal portions in equal times; equal portions in certain unequal times, and so on; and similarly with

regard to proportions. It is readily observed (vi.), from inspection, that equal *portions* in equal times do not represent the facts. The algebraical form for a uniformity of this character would be $a - qx$. Instead, then (vii.), of perplexing our search by attempting a mode of mathematical expression for the remaining possible combinations, we may properly be guided by a general reference to other mathematical relations displayed in Nature under the direction of prevailing physical analogies. In the intensity of sound at different distances from the originating source; the illuminating power of light at successive intervals of space; the degree of comparative action of the force of gravity; the strength of repulsion and attraction between small electrified spheres placed at equidistant points,—where the law of the inverse square invariably applies,—we infer that the capacity (which is also *inversely* proportional to the intensity of mortality) may be conjectured to be definitely related to successive and equal intervals,—the corresponding ratio in equal intervals of *space* suggesting, in our subject, a corresponding ratio in equal intervals of *time*. Having also discarded "*portions*," we substitute, for simplicity, "*proportions*," and we then reach the highly probable supposition that the reduction of the inherent power of resistance is appropriately measured, in accordance with other natural phenomena, on the basis of the unit of equal proportions in equal times.

- viii. Professor E. Ray Lankester* wrote upon the general subject in 1870. He held that a closer agreement exists in relation to the duration of life between individuals of the same species than that observable between individuals of different species, but still, notwithstanding that members of the same species present an extensive variation in their length of life, there prevails a probable duration which characterises the species as an entirety; and is fundamentally uniform for all included individuals. He thus distinguishes between Individual and Specific longevity. And although it might be urged that

* On Comparative Longevity in Man and the Lower Animals.

the highest age reached by any individual in the species, *i.e.*, the greatest *individual* longevity, might be regarded as the measure of the *potential* longevity of the species, it must be remembered, in dealing with an extensive number of cases, that the abnormal or exceptional instances should not be mistaken for normal examples, so that the conclusion in respect of a species should not be based upon specimens of this character. And, restricting observation to the Human Race, he suggests that this consideration may prove of inferior importance, and that we should employ the probable after-lifetime of the individual at that age when some crisis has been surmounted, such as the maturity of the reproductive organs, in order to establish a fixed term of comparison with respect to the potential longevity.

To a wide extent, the life of a given species receives its limit simply through the operation of the particular or specific external agencies amid which the species is born, and which it is originally constructed to encounter. There exists one period which is proper to the species in its normal circumstances, which it is unable, by any internal efforts, to extend, since that period is restricted by the precise conditions to which the species has either been created or by which it has been evolved. A second period is equally proper to the species, which man can render evident by removing or modifying some of the natural circumstances and substituting others more conducive to longevity; in other words, altering the environment in consonance with the capacity of the organism for self-adjustment; this period, however, is also limited, and beyond that indefinite boundary no human power can prolong existence. The first period he describes as Normal Potential longevity; the second is Absolute Potential longevity; absolute, that is to say, within man's experience. Civilised man is competent to direct his intelligence so as to affect his own longevity by changing surrounding conditions as no other organism is capable of effecting, so that, in his case, Normal and Absolute longevity are merged.

There exists a limit to Absolute Potential Longevity in many organisms, of an inherent character in the species, which must act in bounding the Normal Potential Longevity.

In some organisms, it would appear that the Absolute Potential Longevity is almost practically unlimited, but, looking to the whole course of Nature, a remote termination may be supposed, which is difficult to define by reason of its distant character. In this class may be included fish, molluscs, many trees and sea-weeds. On the other hand, there is observed in many organisms, as in man, a distinct inherent natural boundary to life, which cannot be averted.

A period inevitably occurs when an equilibrium is established between nervous and muscular [or, in general terms, vital] expenditure and compensating nutrition, and, when growth has ceased, the condition of equilibration might be maintained for an indefinite time were it not that precisely at that epoch a new form of expenditure, involving a serious tax upon the organism, is entailed in reproduction. This additional drain upon the natural and restricted resources hastens the progress to the limit of life.

The earlier the date at which reproduction commences, and the more rapidly it is carried on, the speedier must be the cessation of increase of the animal's bulk, with the consequent augmentation of waste, and its termination in death. We are thus presented with the successive eras of the history of organisms; the period of evolution, including growth and development; the sequent term through which the reproductive activity is expended; and the concluding stage of dissolution and decay.*

It will be evident that the observations and speculations of Professor Lankester, interesting and important though they are, do not afford any very serviceable assistance in the discussion of our subject,—the possibility of expressing these biological phenomena in any approximately quantitative form.

III.—THE NATURAL DURATION OF LIFE.

- i. M. Flourens† stated that the natural duration of human life was 90 to 100 years, and that, if the majority of men died at an earlier age, the cause resided in the intervention of

* *Vide* C. Darwin : The Origin of Species : chap. vii.

† *Op. Cit.* : De la Longévité Humaine.

accident, disease, or imprudent habits. But, as Mr. George H. Lewes* justly remarked, this argument is based upon the fallacy that, since some attain the age of 100, therefore, all would reach that limit were there no disturbing causes (*des causes troublantes*) but, inasmuch as these counteracting circumstances constitute a portion of the conditions of human existence; inasmuch as man is dependent upon the atmosphere, climate, and food, with their variations; the deduction that he would survive a century, were it not for these opposing influences, is precisely equivalent to the vacant statement that he would enjoy a longer life if life itself were otherwise ordained.

- ii. The Scientific Naturalist, Haller,† considered that longevity appeared to attach naturally to man; (*longœvitas ergo mihi videtur homini naturaliter contingere*); and that, in those instances where he failed to attain decrepit old age, the event occurred “casu,” or from some cause established in the constitution of his frame. In the section, entitled “Longœvitas Antidiluviana,” he even remarks “*nihil repugnat quin longœviores quam nostro ævo homines olim fuisse potuerint.*” This ultimate modern stage, which he estimates to be 200 years, is destined to man by Nature, and is only frustrated by chance or internal injury. But with reference to the assessment of the real limit, he adds (§ Longœvitas Hominis), “*Annos definire erit difficilior.*” Hufeland‡ affirmed that it might be laid down “with the greatest probability” that the limit of life might be fixed at not less than 200 years; and he bases this estimate on his ratio of growth to duration; for as man requires 25 years for complete development, so the natural extension of his life is $25 \times 8 = 200$. Mr. G. H. Lewes§ rightly comments that the period in question possesses no magical finality; why not propose that, if 200 can be

* G. H. Lewes, *The Physiology of Common Life* : Vol. ii. : chap. xiii.

† Op. Cit. : “Old Age and Death.”

‡ Op. Cit. : chap. vi.

§ Op. Cit. : Vol. ii. : chap. xiii.

attained, so can 300, and so on, until some *necessity* can be shown for the termination. Hufeland* very justly marks a distinction, in its bearing upon longevity, between an *intensive* and an *extensive* life, involving the comparative proportions of vital expenditure.

IV. THE VALUE OF AN ADEQUATE DEFINITION OF LIFE.

It is evident that if we possessed an adequate Definition of Life, our enquiries into the conditions affecting abnormal longevity would be happily facilitated. But, obviously, a competent and comprehensive Definition† must be based upon the essential elements of the problem which it professes to circumscribe; and, apparently, philosophical Scientists and Naturalists have achieved insignificant progress in this domain. The period for serviceable generalisation has not yet arrived. As a specimen of the ineffective Definitions which have been proposed in the past, I will merely mention,—omitting those of Stahl, Cuvier, De Blainville, and Kant‡,—that suggested by the physiologist, Bichat,—“Life is the Sum of the Functions by which Death is resisted.” Here it appears to me that we perceive an example of the ancient fallacy of *Circulus in Definiendo*.§ The term, “death,” included as the explanatory polar or antithesis of *Life*, requires elucidation itself, and therefore involves essentially the definition appertaining to Life; the word, “function,” in this connexion, implies *vital* characters which demand, for their understanding, a prior exposition of Life itself; while the insertion of the term, “Sum,” implicates necessarily the enquiry whether it signifies mechanical or arithmetical addition, or (as the former clearly cannot be the case), a *vital* combination, which once more postulates a knowledge of the meaning of Life; so that the Proposition is vitiated by the fact that every expression employed in explanation depends, for its individual connotation, upon the

* Op. Cit. : chap. ii.

† Whewell : *Novum Organon Renovatum* : Book ii.
J. S. Mill : *A System of Logic* : Vol. i. : chap. viii.

‡ Whewell : *A History of Scientific Ideas* : Vol. ii. : Book ix. : chap. iii.
G. H. Lewes : *The Physiology of Common Life* : Vol. ii. : chap. xiii.

§ Stanley Jevons : *Logic* : chap. xii.

explication of the very Definition it is introduced to expound. Mr. Lewes* properly remarks that the proposition is a mere paraphrase of the truism that life is the means by which we live.

The student will recall the famous Definition of Mr. Herbert Spencer.†

V. MINOR NOTES.

- i. Jerome Cardan, Naturalist and Physician, the Admirable Crichton of his period, suggested, in his work *De Subtilitate*,‡ that the length of life was dependent upon a lessened amount of exercise; trees live longer than plants because, from fixity of position, they can obtain little exercise; for exercise increases transpiration, and transpiration reduces life.
- ii. Lord Bacon§ proposed a similar notion, and advocated the employment of oily substances for the purpose of preventing transpiration.
- iii. In the earliest ages, we find a system of *Gerocomic*, or the art of prolonging life, where fresh strength was supposed to be infused into an enfeebled body by "exposing it to the "effluvia" (in Hufeland's phrase) of vigorous and blooming youth. It is curious to note that schoolmasters usually attain advanced ages, and I leave it to the physiologist to determine whether the fact furnishes an exemplification of this ancient doctrine.
- iv. The stars, too, were formerly believed by Bishops and philosophers, as well as the "profanum vulgus," in ancient and comparatively modern times, to exercise a constant influence upon longevity; and, as soon as a patient learnt the origin of his disease, tending to shorten life, as inherent in some presiding Constellation or planet, he must simply employ the kind of food and drink, and transfer himself to a fresh place of residence, which were governed and favoured by the

* Op. Cit.: Vol. ii.: chap. xiii.

† The Principles of Biology: Vol. i.: Part i.: chap. iv.

‡ Cited by Flourens.

§ Cited by Flourens.

opposing planet. Let him merely desert the spot, and abandon the nourishment and medicine, which were under the régime of the malignant star, and substitute the locality and nutriment peculiar to another stellar benignity in antagonism to the astral enemy, when the influence of the disastrous planet would be promptly annihilated. Planets mysteriously loved or hated man.

- v. The use of talismans and amulets, with the same object, was adopted on account of certain metals possessing an intimate connexion with the various stars ; to wear a talisman of the proper metal, which had been melted, cast, and stamped under certain constellations, bestowed upon the happy bearer, the potency and protection of the associated planet. There were also constantly suggested, for attaining prolongation of days, various Elixirs, or Tinctures, of Life, the "aurum potable," as the "noblest" metal in the hierarchy of the Alchemist, and, super-eminently, the "Lapis Philosophorum," which, in addition to its universal capacity of transmuting the "baser" metals into gold, possessed the inherent power, when discovered, of indefinitely extending life. (I need not point out that the word "stone" was employed to indicate the primary underlying "substance" [in the scholastic phrase], which formed the universal ground of natural phenomena and their transformations).
- vi. The transfusion of blood was a favourite device for prolonging life ; the veins of the decrepit patient were opened, and the blood of some vigorous and virile youth was injected into the system with invigorating effect. This experiment was attempted in the earlier annals of our Royal Society.* In 1666, transfusion was performed upon various animals ; and, incited by an account of experiments on human subjects conducted at the Academy of Sciences in Paris, the Royal Society became desirous of adopting it in England, and Sir George Ent suggested that it would be most important to

* C. R. Weld : A History of the Royal Society : Vol. i. : chap. viii.

make the experiment upon "some mad person in Bedlam." The proposal was generally approved; a Committee was appointed to communicate with the Physician of the Hospital for the purpose of providing a lunatic; but the Physician promptly declined, and no patient was lunatic enough to offer. Dr. Thomas Burnet,* in 1680, summed up the position by dogmatically asserting that elixirs and philosophers' stones were absolutely futile, and that the sole and adequate mode of extending life consisted in capturing the sun,—he refers to this point, I would add, more soberly and solemnly than I do,—and placing him in the primitive relation to the Earth which he occupied in Antediluvian days.

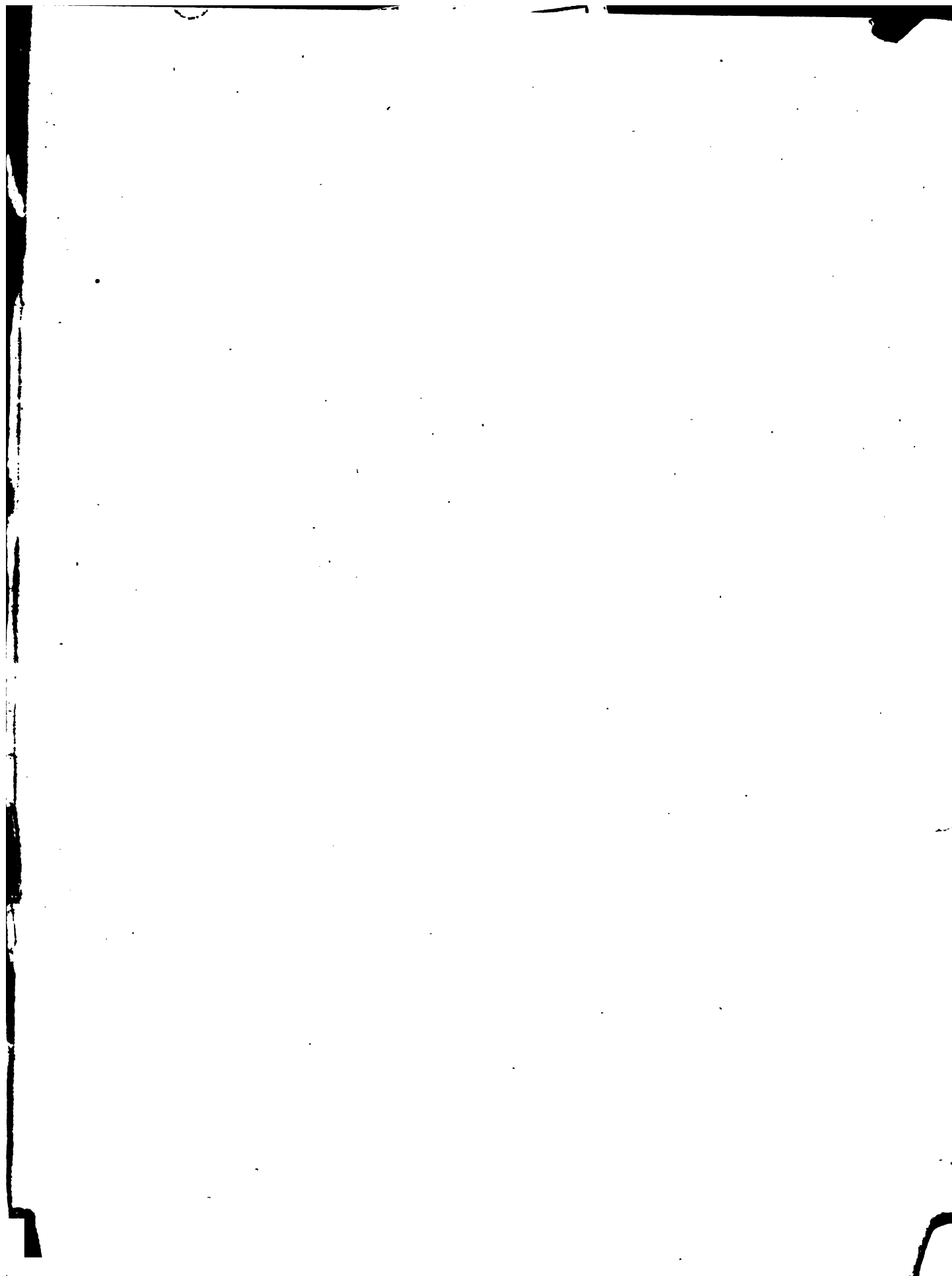
* The Sacred Theory of the Earth.

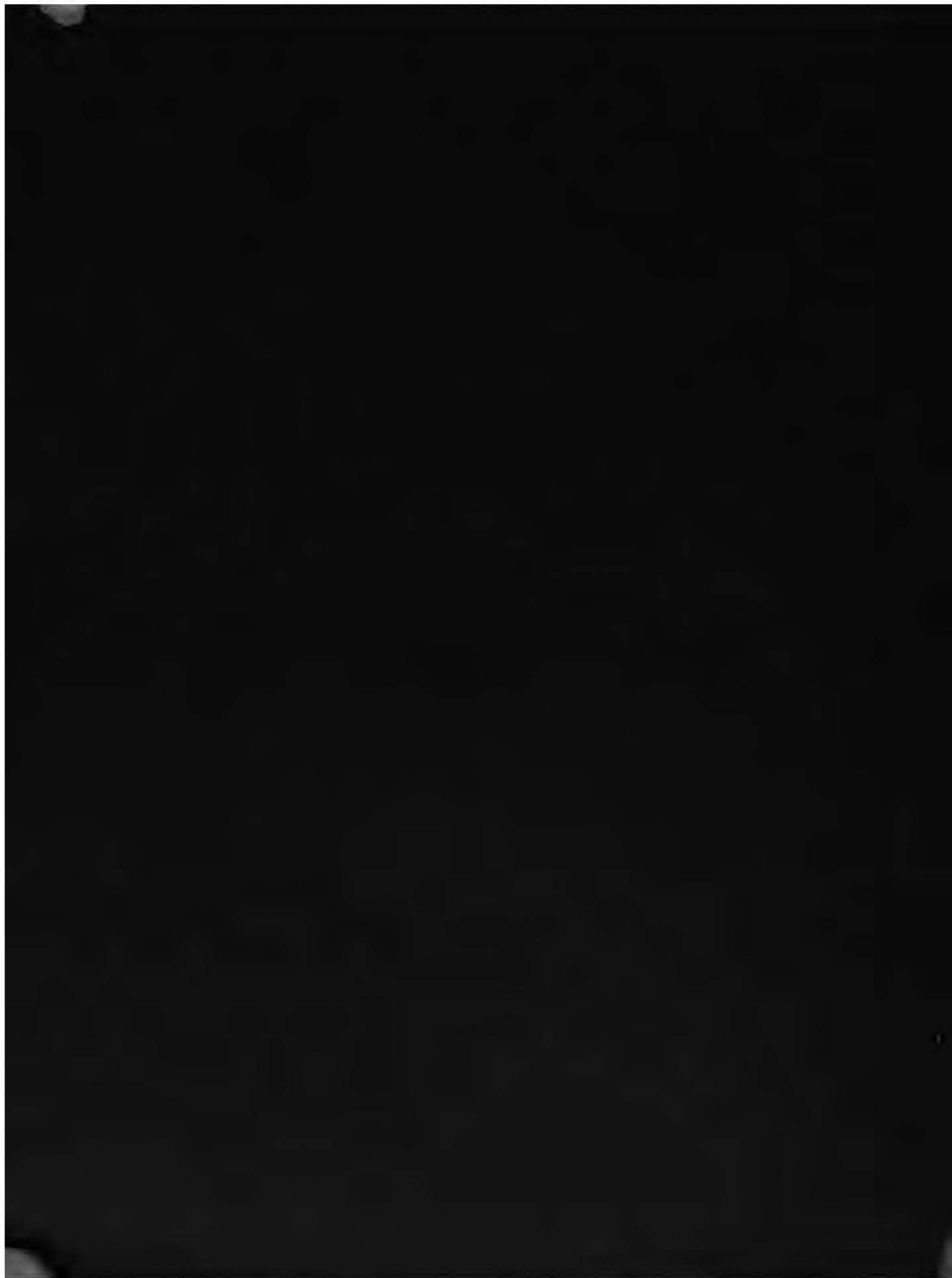
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